MACHINERY.

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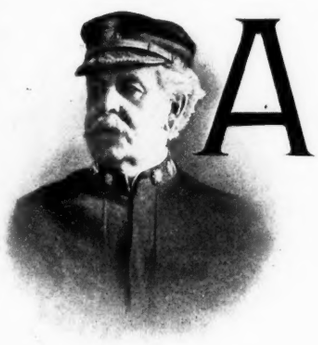
STEAM ENGINEERING DEPARTMENT SHOPS, N. Y. NAVY YARD.



Commander J. A. B. Smith.

A FEW months more than three years ago, the date being February 15, 1899, the shops of the Steam Engineering Department at the New York Navy Yard, were practically all destroyed by fire, the foundry building and boiler shop being the only buildings not burned. What at that time, superficially viewed, appeared like a great loss to the Navy Department, was undoubtedly a blessing in disguise, as developments have shown. The old gloomy shops with their antiquated tools and equipment, were swept away at one stroke and the way left clear for new buildings and up-to-date equipment. That the opportunity has been fully improved by the naval officials is the opinion of the writer, who made a recent visit to the new buildings of this department. In fact we believe we are safe in saying that the new Steam Engineering shops of the New York Navy Yard are the best built and best equipped shops for the repair and building of marine steam engines in the United States, if not in the world. These shops should be as much a matter of national pride to the patriotic citizen as any of the vessels constituting the new navy, because adequate building and repair shops under Government control, are vitally essential for maintaining its efficiency. The one is as necessary as the other since extensive repairs to war vessels are constantly necessary. The failure to keep them in the best possible condition might result in a great national disaster in case war was suddenly declared. Witness the result to Spain of the battle of Santiago—it might have been quite quite different had Cervera's ships been kept in proper repair.

The design of the new shops and their arrangement was made by the Bureau of Steam Engineering, Washington, D. C., under the supervision of Rear Admiral Geo. W. Melville. The mechanical and electrical apparatus were arranged under the direction of Commander J. A. B. Smith, head of the Steam Engineering Department of the New York Navy Yard. The plan of the machine shop is shown by Fig. 3. The machine shop and the erecting shop are joined so as to form an L. The old boiler shop is connected to the side of the machine shop at the opposite end from the erecting shop so that the three shops form a huge U. At the far end of the boiler shop the new blacksmith shop was erected continuous with the boiler shop building. Opposite the opening of the U is the new power house. The new administration or office

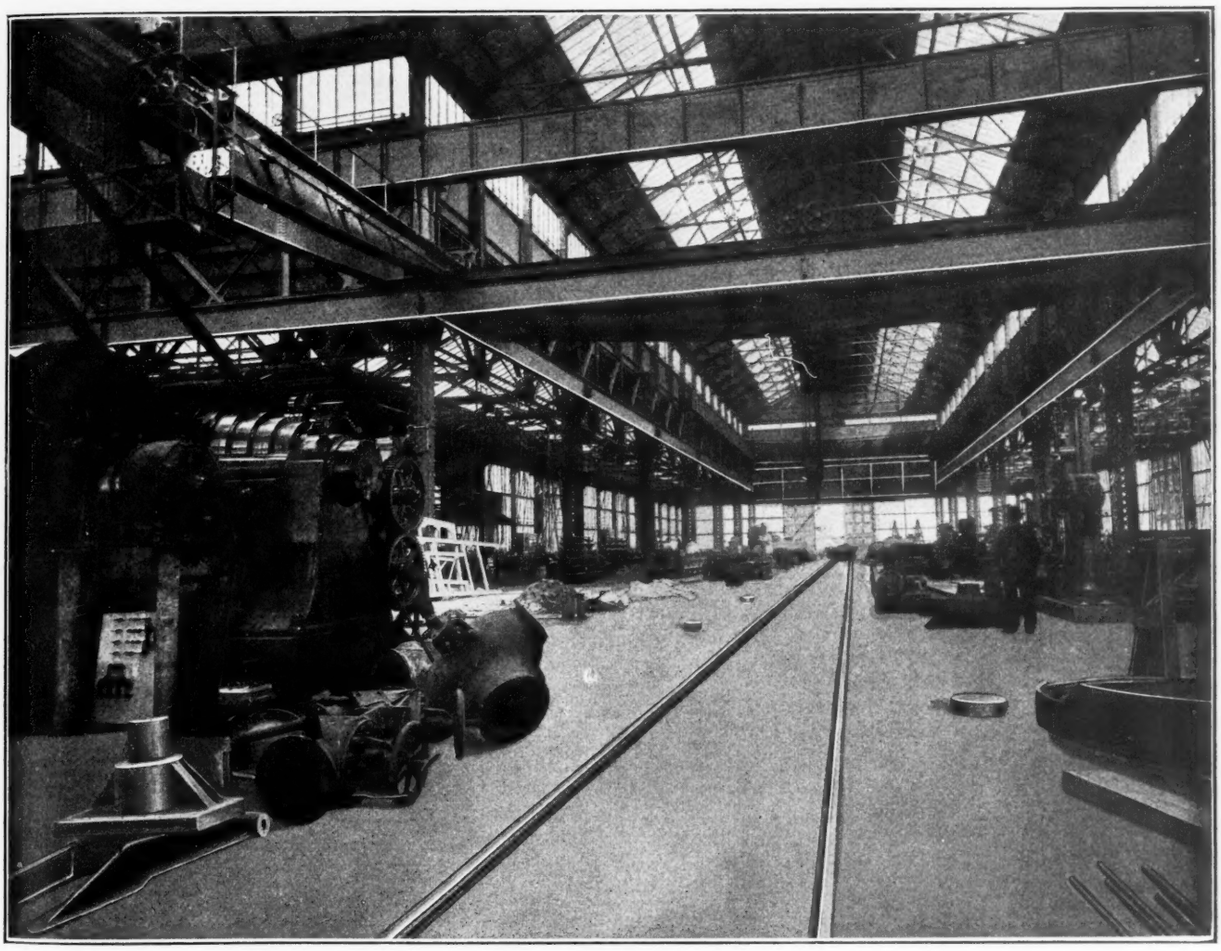


Fig. 1. New Erecting Shop, New York Navy Yard Steam Engineering Department, 130 feet wide and 252 feet long.

building, is opposite the south end of the machine shop, and closely adjacent is the new two-story building for the pattern shop and pattern storage. The old foundry and copper shop building lies beyond the machine shop on the west side opposite the power house. From this it will be seen that all the buildings of the steam engineering department are quite closely grouped, but this convenience does not increase the fire hazard since all the buildings are strictly fire-proof. The dimensions of the principal buildings follow:

The machine shop is 130 x 350 feet; erecting shop, 130 x 252 feet; boiler shop and blacksmith shop, 96 x 300 feet; two-story pattern shop, 60 x 195 feet; foundry and copper shop, 100 x 350 feet; two-story office building, 60 x 100 feet; and the power house, 86 x 100 feet. The power house is exclusively for this department, there being two other power plants in the yard. Between the two legs of the U and opening into the machine shop, is the tool-issuing department.

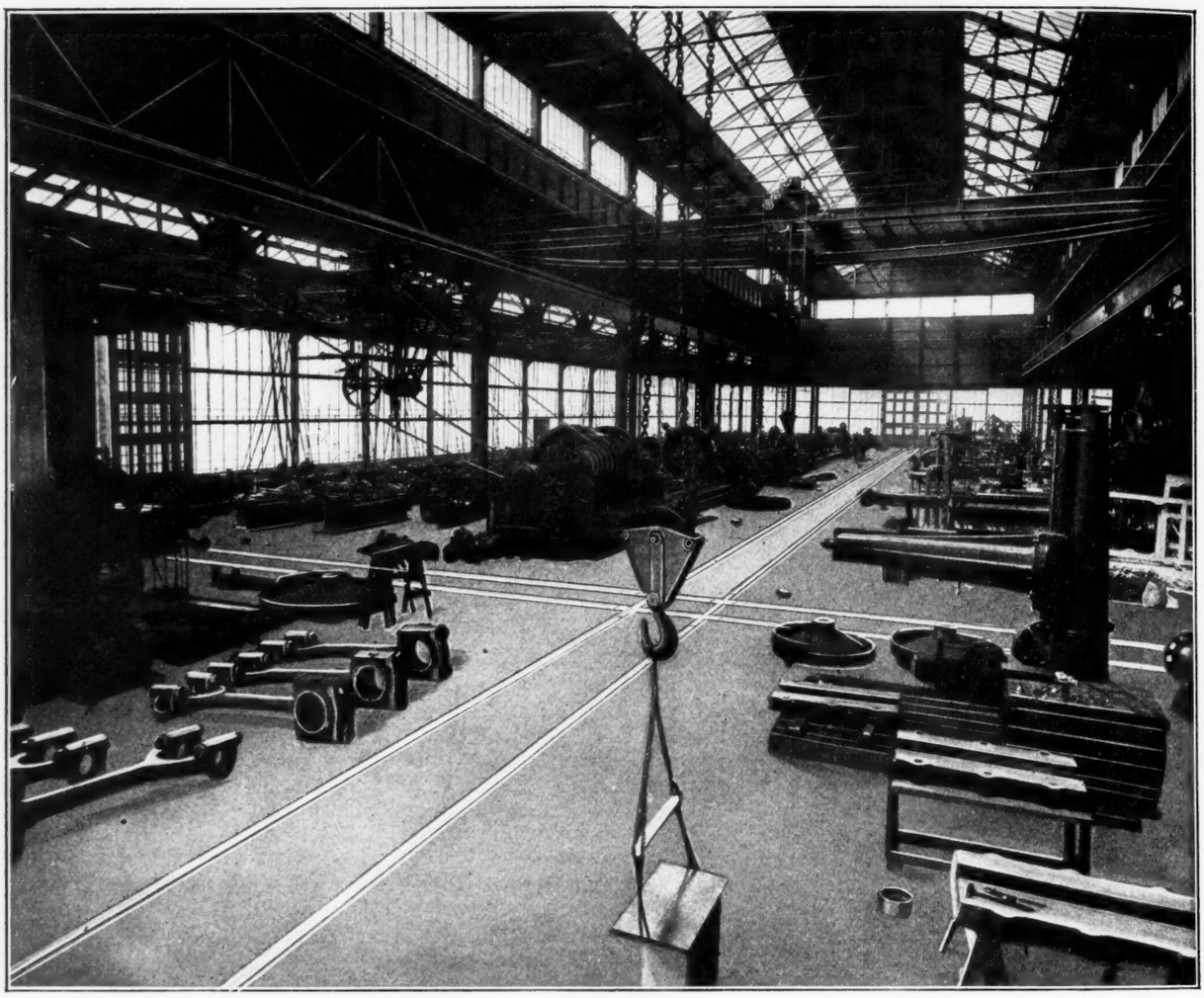


Fig. 2. New Machine Shop, New York Navy Yard Steam Engineering Department, 350 feet long and 130 feet wide. Both this and the Erecting Shop are Literally "Light as Day."

the tool-making department and the machinists' clothes and wash-room. The dimensions and arrangement of these departments are set forth in the plan, Fig. 3.

A division wall separates the boiler and machine shops, but there is no division wall between the machine and erecting shops, the two departments being the same as one large room bent at right angles near its middle. One feature that powerfully impresses the visitor in either of these shops is the great flood of light that illuminates every part. It could not be otherwise with the great area of glass in the sides and roof. The walls are brick, up four feet from the ground. Above they are steel columns and glass. The roof is of the monitor or clearstory type for both the machine and erecting shops. In fact both buildings are of the same general form of construction throughout. The floor space is divided into three longitudinal sections by the roof supporting columns. The central space is 70 feet wide and is covered by the monitor portion of the roof. The monitor is 18 feet high at the sides and the upper half of the sides is glass the full length and across the ends. Each side of the roof contains a skylight 17 feet wide also running the full length. Over the side aisles which are each 30 feet wide, there are skylights 13 feet wide running the full length. The lighting of the roof is very well illustrated by the general views, Figs. 1 and 2. The glass is set in steel frames and the roof is made of concrete and slate so that there is a total absence of all inflammable material. This condition is found throughout. The floors are of cement, and are painted to prevent grit wearing off and getting onto the machinery. In the screw machine department, however, the floor is covered with galvanized iron which in effect forms a huge oil pan covering the entire floor area occupied by the screw machines, bolt cutters and pipe machines.

All shelving is made of iron and partitions are of brick, sheet steel or wire netting. Of course in the tool-room it has been necessary to use some wood in the construction of some of the tool trays and racks, but the total amount of wood so used is so small that it is practically negligible so far as the fire risk is concerned.

The heating apparatus is of the type in which air is blown over steam pipes and is known as the steam hot-blast blow-through type. It was furnished by the B. F. Sturtevant Company. There are four sets in the machine and erecting shops, one at each corner of the ends of the L. The fans for each set are three in number 54 inches in diameter and mounted on one shaft. The fans are driven by Westinghouse alternating current motors of 30 H. P. each. The hot air discharge pipes are carried down by the central roof supporting columns so that each one discharges within 35 feet of the

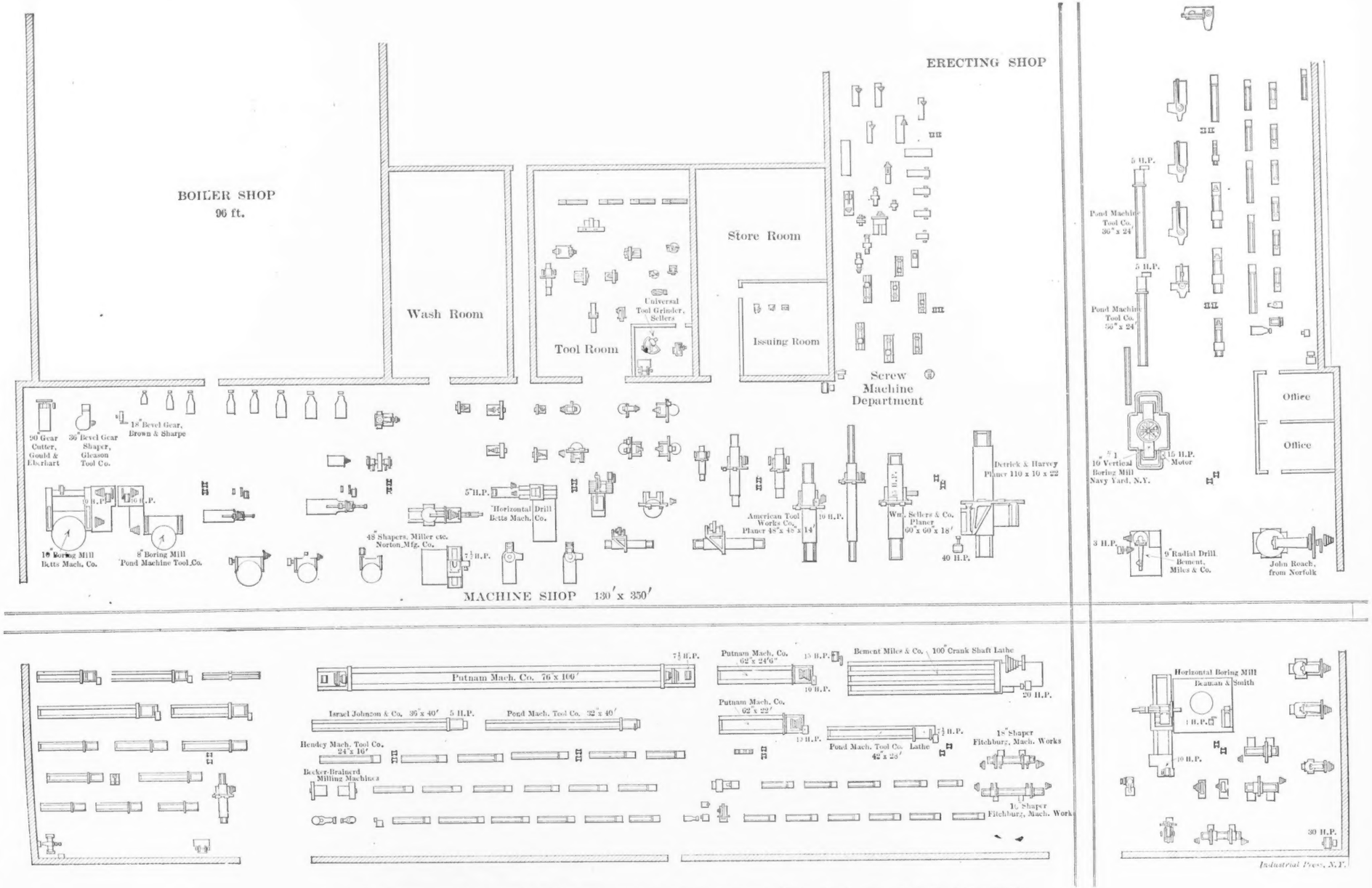

BOILER SHOP
96 ft.
Wash Room
Tool Room
Universal Tool Grinder, Sellers
Store Room
Issuing Room
ERECTING SHOP
Screw Machine Department
90" Gear Cutter, Gould & Eberhart
36" Bevel Gear Shaper, Gleason Tool Co.
18" Bevel Gear, Brown & Sharpe
10 H.P.
15 H.P.
16" Boring Mill Betts Mach. Co.
8" Boring Mill Pond Machine Tool Co.
5 H.P.
Horizontal Drill Betts Mach. Co.
48" Shapers, Miller etc. Norton Mfg. Co.
7½ H.P.
American Tool Works Co. Planer 48"x 48"x 14'
10 H.P.
Wm. Sellers & Co. Planer 60" x 60" x 18'
15 H.P.
Detrick & Harvey Planer 110 x 10 x 22
40 H.P.
MACHINE SHOP 130' x 350'
5 H.P.
Pond Machine Tool Co. 36" x 24'
5 H.P.
Pond Machine Tool Co. 36" x 24'
Office
Office
5 H.P.
16" Vertical Boring Mill Navy Yard, N.Y.
15 H.P. Motor
3 H.P.
9" Radial Drill Bement, Miles & Co.
John Roach, from Norfolk
7½ H.P.
Putnam Mach. Co. 76" x 100'
Putnam Mach. Co. 62" x 24'6"
15 H.P.
10 H.P.
Bement Miles & Co. 100" Crank Shaft Lathe
20 H.P.
Israel Johnson & Co. 36" x 40' 5 H.P.
Pond Mach. Tool Co. 32" x 40'
Putnam Mach. Co. 62" x 22'
15 H.P.
Hendey Mach. Tool Co. 24" x 16'
Pond Mach. Tool Co. Lathe 42" x 23'
7½ H.P.
18" Shaper Fitchburg, Mach. Works
Becker-Brainerd Milling Machines
16" Shaper Fitchburg, Mach. Works
Horizontal Boring Mill Beaman & Smith
10 H.P.
30 H.P.
Industrial Press, N.Y.

Fig. 3. Arrangement of Tools in Marine and Erecting Shops, Department of Steam Engineering, Navy Yard, New York.

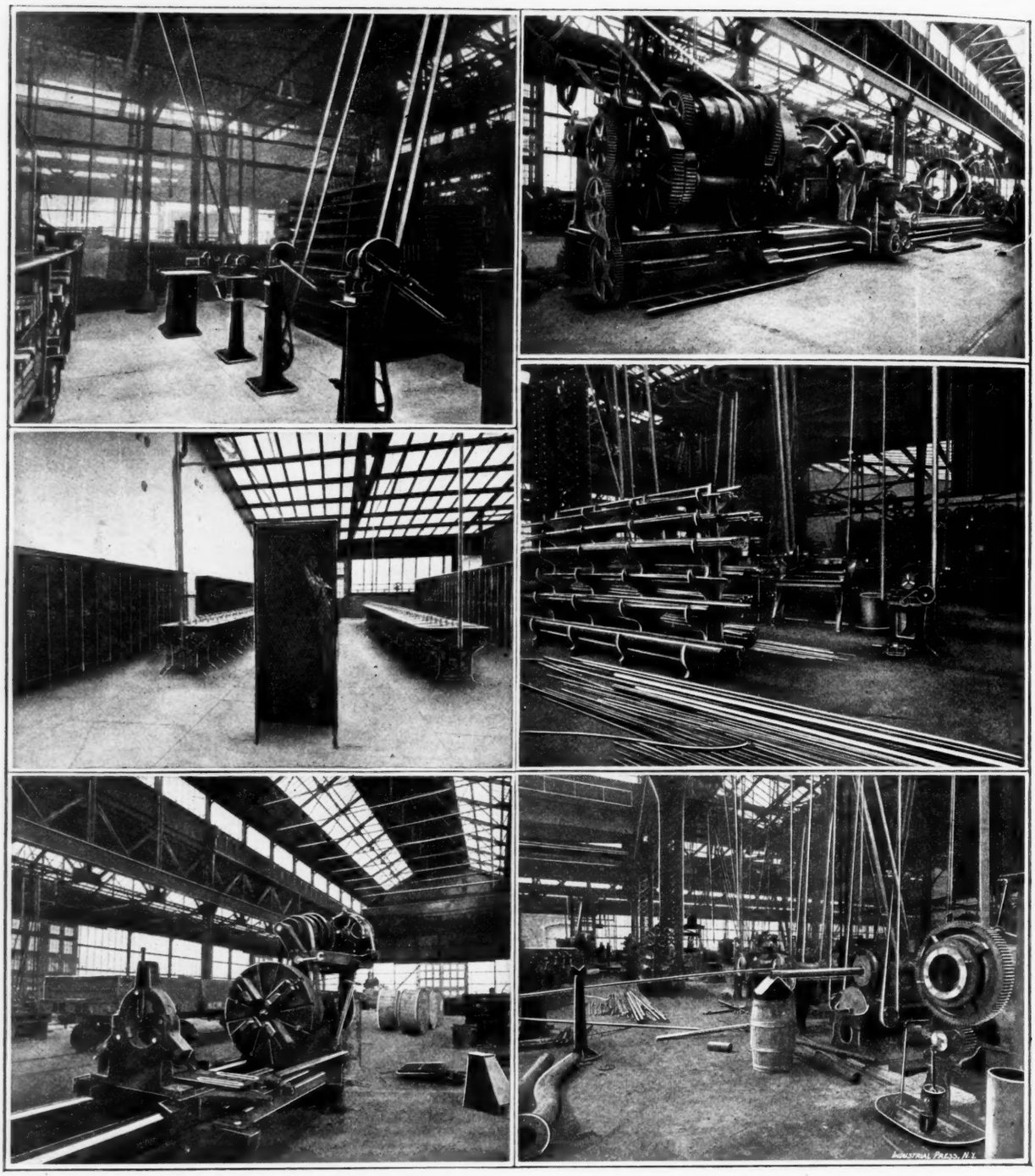


Fig. 4. Issuing Department, showing Grinders and part of Check Board.
Fig. 5. Bement, Miles & Co. 100-inch Crank Shaft Lathe.
Fig. 6. Machinists' Wash Room and Expanded Metal Clothes Closets.
Fig. 7. Screw Machine Department and Stock Rack.
Fig. 8. Engine Lathe showing Method of applying Motor and Countershaft Cone
Fig. 9. Pipe-cutting Department.

center of the shop. During last winter the temperature of these large shops was raised 34 degrees in 30 minutes on one occasion.

The machine shop and the erecting shop are served by three traveling cranes each. The motors are of the direct-current type, but all other motors in these shops are of the Westinghouse two-phase alternating current type except a direct current machine in the boiler room for operating the Roney stokers. In the machine shop the large Morgan crane is of 25 tons capacity. This runs on the upper tracks and is used when the maximum lifting power or head room is required. The two cranes on the lower tracks are of 10 tons capacity each and were made by Pawling & Harnischfeger. In the erecting shop the upper crane is a Niles of 40 tons capacity and the lower ones are of the same capacity and made as those in the machine shop, all having three motors.

Running through the center of both the machine and erecting shops, there is a railway track of standard gage for the transportation of work and materials between the different shops and the docks. There is also through part of the outer end of the erecting shop a track of 18-foot gage which will be extended to Wallabout Bay (a branch of the East River) for the transportation of work too large or heavy for the standard gage cars. On each side of this wide gage track near the doors, a section has been driven with piles to provide suitable foundations for the erection of heavy marine engines.

Having briefly mentioned the main features of the shop buildings we will turn our attention to the machine tools and the electrical apparatus installed for their operation. All the tools are electrically operated, the larger ones by separate motors and the smaller ones from line shafts driven by motors. Alternating two-phase current motors of the Westinghouse constant speed type are used. They are wound for 3,000 alternations per minute and 200 volts. The line shafts

have motors belted to each end and are provided with clutches in the center so that one-half the shaft may be run without running the other. One motor may also be employed to run the whole shaft when the work is light as it is at the present time. In that case the belt is simply removed from one motor and it is allowed to stand idle while the other motor at the opposite end runs the shaft. The constant speed motors are admirably suited to line shaft operation as there is in this service no call for varying speed. Having no commutator and being, therefore, sparkless they require the minimum of care and attention. When used for the direct operation of

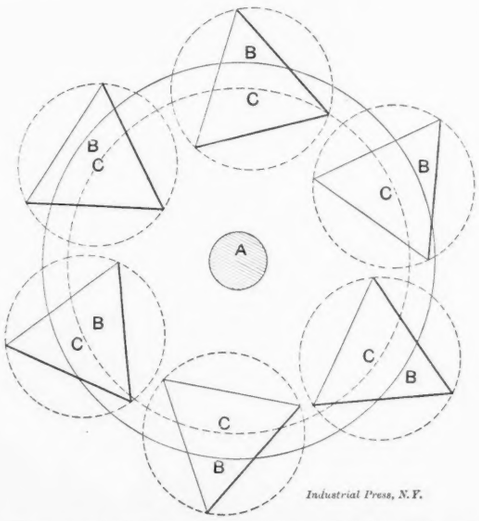


Fig 10. Diagram showing Plan of Check Board used in Issuing Department.

machine tools provision must be made for varying the speed of the work spindles. The plan generally adopted in these shops for lathes is that shown in Fig. 8, which shows a motor and a cone pulley mounted on a tilting table above the headstock of the lathe. The table is pivoted at *C* so that when it is tipped one way, the short belt connecting the two cones is tightened and when tipped in the opposite direction it is loosened. The pivot of the table is so located, or rather the motor and the cone pulley are so set on the table that it overbalances in the direction to tighten the belt and thus keeps a constant tension on it. When the operator wishes to shift the belt from one cone to the other he tips the table by means of a lever and loosens the belt. Suitable means are provided for holding it in this position if desired. So easily is the belt loosened in this manner that it is quite commonly done to stop a lathe for a brief period instead of stopping the motor by opening the switch. Incidentally this system demonstrates that the theory of long distances between centers being necessary for successful belt driving, is true, under ordinary conditions, only so far as it favors a constant belt tension. If the belt tension can be kept constant without having to depend on the natural elasticity of long belts the short belt will work practically as well when the pulleys so connected do not have a difference in diameter greater than the large and small steps of the average lathe cone pulleys.

One of the largest tools in the machine shop is a 100-inch crankshaft lathe built by Bement, Miles & Co.. This huge machine has a 50-foot bed and takes 32 feet between the centers. The bed is built with double ways or shears so there are in practical effect two parallel beds with one headstock and one footstock. On these are mounted two tool carriages, one in front and the other at the back. Each carriage has its own lead and screw and splined feed rods so that they are entirely independent. One carriage may be shifted from one end of the ways to the other without interfering with the other. The tailstock is mounted on the two middle ways. All the ways are of the flat English type. The lead screws for the carriages are centrally located and a screw is provided for moving the tailstock. The lead screws are 4 inches in diameter. Threads may be cut from 12 per inch to one in 24 inches. The carriages and footstock may be shifted without operating the headstock mechanism. An independent motor of 15 H. P. is provided for this purpose and mounted on the floor at the tailstock end of the bed. Clutches are provided so that either carriage or the tailstock may be shifted, at will. The spindle is driven by a 20-H. P. motor which is mounted on a shelf at the back of the headstock and which is shown in the left foreground, Fig. 1. In this case the motor is belted to a countershaft which in turn is belted to another countershaft over it. From this countershaft which carries the cone pulley, a belt is carried to the cone pulley of the headstock. This peculiar arrangement may be seen in the general view, Fig. 2. Its object is presumably to permit the use of a two-speed countershaft.

The next lathe in point of size is a 70-inch Putnam double-head lathe having a bed 100 feet long and taking 70 feet between the centers. This lathe is really two lathes built together with a continuous bed. For ordinary work each headstock is used with its own carriage and tailstock. For very long work one tailstock is removed. At the time of the writer's visit to the shops one of the tailshafts of the Baltimore was in this lathe for turning down the bronze liners which had been renewed. The shaft was, of course, supported by steady-rests so that very little of its weight was carried by the lathe centers.

The largest horizontal boring mill in the machine shop was built by Beaman & Smith and is called by them a horizontal spindle drilling, boring, tapping and milling machine, since it is adapted to perform these various operations. It has a floor plate or work table 14 x 16 feet x 15 inches high. The table has fourteen T-slots planed from the solid, for bolting down work. A circular detachable table is also provided which is graduated in degrees and which may be rotated when setting work, either by hand or power. For moving it by power an independent 1 H. P. motor is mounted on the table and connected to a worm which meshes in worm teeth

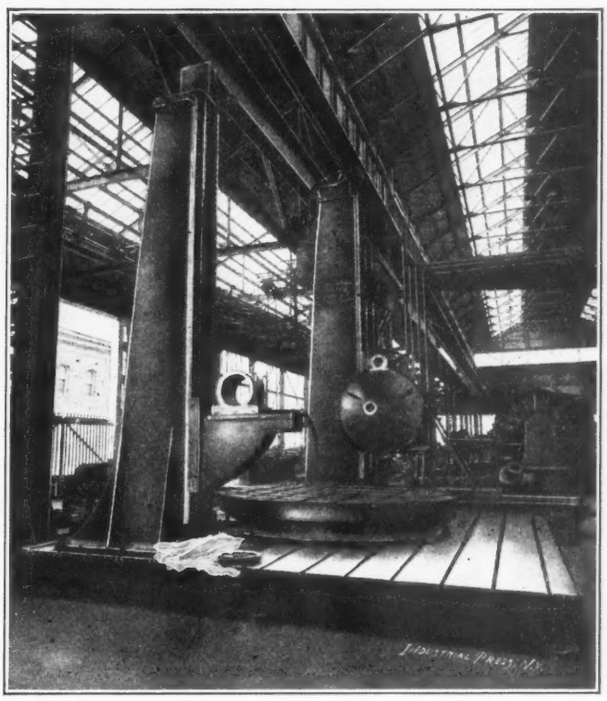


Fig. 11. Beaman & Smith Horizontal Boring Mill. Table, 14 x 16 feet; Uprights or Housings, 15 feet high.

cut in the periphery of the circular table. The main column carrying the spindle-driving mechanism is 15 feet high. It has a traverse on the bed of 14 feet. The bed is 21½ feet long and 5 feet wide and is connected to the platen or work table by an adjustable joint that permits of aligning the spindle with the platen when it has gotten out of truth by wear or settling. The spindle is 8 inches in diameter and is driven by a 10-H. P. motor. All movements are controlled from the operator's platform, which is fastened to the head and has vertical movement to accommodate it to the height of the spindle. The total weight of this machine is 60 tons.

The largest planer is of the open side extension type built by Detrick & Harvey. This tool has a capacity of 100 inches by 120 inches by 22 feet. The same firm built four other open-side planers of smaller dimensions for the machine shop.

The largest vertical boring mill in the shop was built by the Betts Machine Co. It is a 10-16 foot extension mill, that is it swings 10 feet when the housings are in the normal position and 16 feet when shifted back. It has an auxiliary cross-rail which is fitted with an independent adjustable spindle head for boring and facing work when the mill is extended.

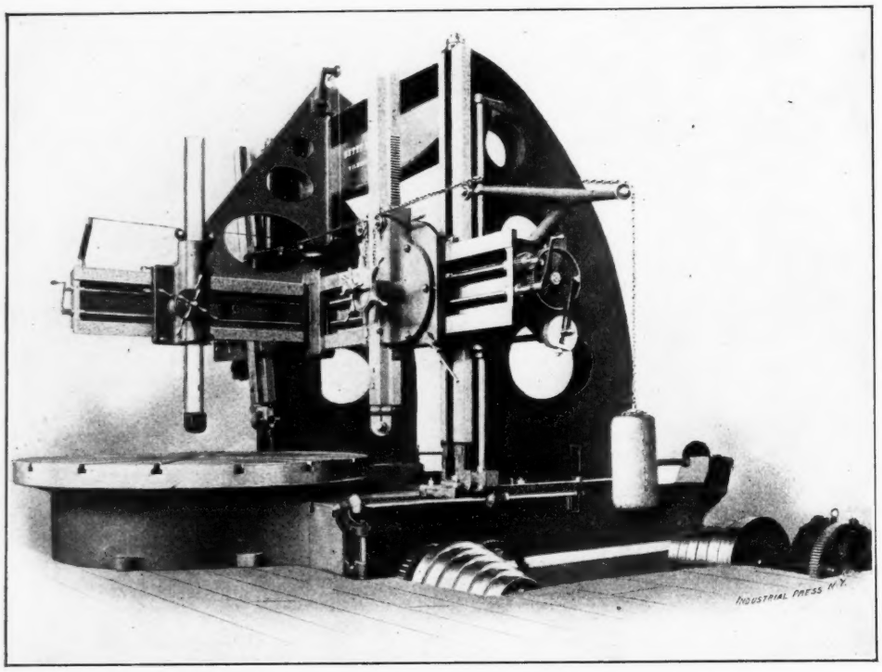


Fig. 12. Betts Machine Co. Boring Mill with Extension Boring Bar.

A Gould & Eberhardt new type gear cutting machine is included in the machine equipment. This tool cuts spur gears up to 90 inches diameter, 16 inches face and one diametral pitch. It is provided with automatic worm hobbing attachment and automatic rim clamp for holding the rims of large gears to prevent creeping as the cutting proceeds. This tool will probably find legitimate use in cutting the teeth of wormwheels used on marine engines for the turning engines.

A 76-inch Bullard boring mill is another of the machines having special features. It has two heads, one of which can be set at any angle, as is the usual construction. The left-hand head has a revolving spindle and is without swivel. This tool is built only to order and is designed especially for engine work such as turning crank disks and boring both holes at one setting. A smaller mill (62-inch) has the same feature.

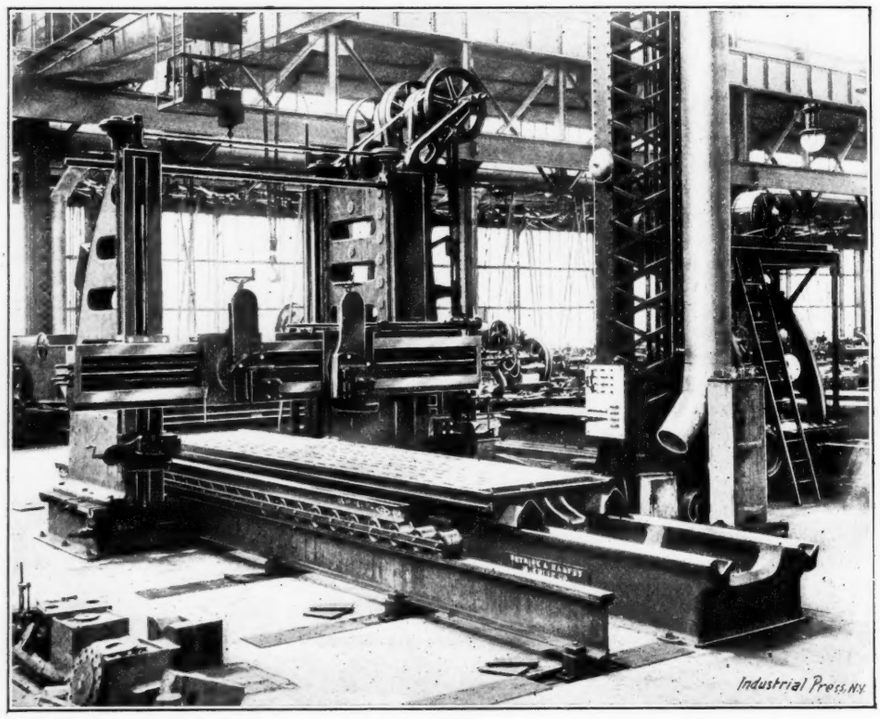


Fig. 13. Detrick & Harvey Extension Open-side Planer, 40 H. P. Motor for Driving.

By referring to Fig. 3, and also the appended list of manufacturers, it will be seen that the various makers of machine tools are quite fully represented. The cut shows the positions of the various tools, their sizes and the power of the motors required for their operation in case they are independently operated. There are in all about seventy lathes, eleven planers, twenty vertical and horizontal boring mills, twelve shapers, six slotters and key seaters, twelve milling machines, nine radial drills, thirty-seven drill presses and sensitive drills, three gear cutters, eight pipe machines, and twenty-four screw and bolt machines. There are fifteen grinders of all kinds, including a Landis universal machine 12 inches swing and 44 inches between centers. There is also a plain Landis grinder having a capacity of 20 inches swing and 144 inches between the centers. These tools and a few others are not shown in Fig. 3 as they are located in the further end of the erecting shop which is not all included in the cut. Part of the fifteen grinders referred to are in the tool room where all the grinding of lathe and planer tools, milling cutters, reamers, etc., is done.

One of the largest slotters is a tool built by John Roach in 1868. Although this tool was built thirty-four years ago, it compares very favorably with some modern tools in point of construction and design. Until brought to the New York yard it had been in the Norfolk yard where it had done little or no service, and is therefore nearly as good as new.

A large vertical boring mill for boring engine cylinders is now in process of construction in the machine shop. This tool is of the revolving bar type. It is to be driven by an electric motor which will be located within one of the housings to get it out of the way.

At the present time there is so little work in progress that it is not possible to give an extended account of the general practice carried on. However, we may mention the manufacture of condenser ferrules. These are being made on a Brown & Sharpe semi-automatic turret lathe from heavy bronze tubing. The daily production is very creditable, having reached 1,400 per day of eight hours. The ferrules are

threaded, counterbored and cut off in the lathe, the subsequent operation of slotting for a screw-driver being all that is necessary to complete them. Of course making the ferrules from tubing makes it possible to turn out far more per day than would be the case if they were made from solid stock.

In the description of the Putnam lathe it was mentioned that it was at work on one of the tailshafts of the Baltimore, finishing the bronze liners or bushings which had been renewed. These liners are made of bronze and are shrunk in place. They are made in sections about 3½ feet long and in this case four were used on each shaft. In shrinking them in place care must be taken to get them closely abutted, otherwise there would be a crack between them that would allow the ingress of sea-water and cause corrosion. In case cracks are left it is necessary to calk in wire to make it tight. Of course precautions are taken to prevent this condition in the shrinking operation. When one liner is shrunk in place the next one is brought up solidly against it and the end abutting is cooled off first. When it has "seized" the shaft the remainder is then cooled. When properly done there will be no space between the ends of the abutting liners. Strange to say, the boring of these bushings is done on a lathe with a long tool held on the carriage. It would seem that a horizontal boring mill would be much better adapted to the work.

A double checking system is used in the tool-issuing department. When a machinist calls for a tool he presents a check bearing his number. The required tool is given him and his check hung in its place. Then the tool check of which there is one for each tool, is hung on the check board beneath the machinist's number. Thus it is possible to tell at a glance at the check board what tools any machinist has in his possession. For example, suppose the John Smith whose number is 247, presents his check for a rose-bit reamer. The reamer has hanging near it or over it a check bearing a number, which we will call 10, and also the name of the tool-"rose-bit." The check No. 247 is hung in place of the tool check No. 10 and this check is hung on the check board beneath No. 247.

The check board in use is so constructed that a great many numbers are accommodated in a small space and in a manner that makes reference to them very easy. It consists of a frame mounted in a vertical position on a vertical spindle and having ball bearings so it may easily be shifted around by hand. This frame carries six sections, *B B B*, etc., Fig. 8, which are also mounted on vertical spindles with ball bearings so that each one may be rotated relative to the main frame carrying them. The parts *B B B*, etc., are triangular in cross-section, as indicated in the cut. Each face is covered with twelve rows of numbers, eight in a row. Beneath the numbers are the hooks for the checks. In this way eighteen separate sections, carrying 1728 numbers, are provided within a space say, six feet high and three and one half feet in diameter. The upper portion of this check board can be seen in Fig. 4, back of the tool rack.

For the operation of pneumatic tools in the boiler shop a Rand air compressor was installed, which is driven by a 200 H. P. motor. As the capacity of this large compressor was greatly in excess of present requirements a great deal of air was being wasted at the pop safety valve. To stop this loss Commander Smith has had the air pipes connected to the steam pipes leading to the blacksmith shop and now instead of using steam for the operation of the various steam hammers, compressed air is used instead. This practice has been found highly satisfactory. The condensation in the long steam pipe of nearly 300 feet was a large percentage of the steam required to operate the hammers. With compressed air this loss is avoided, and also the heating of the shops which is so objectionable in hot weather, but which is practically unavoidable with steam. The steam hammers work perfectly with compressed air and there is no leakage of condensation upon the work, an advantage that is often of considerable importance. A 2½-ton Sellers hammer is one of the tools operated in this manner.

A further description of this interesting plant will be given next month, which will include a complete description of the power house and electrical installation.

The following is a partial list of the manufacturers of machine tools who are represented in the machine equipment of the New York Navy Yard Steam Engineering department shops:

Lathes.

American Tool Works Co.
Bradford Machine Tool Co.
Bement, Miles & Co.
P. Blaisdell & Co.
Fitchburg Machine Works.
Hendey Machine Co.
I. H. Johnson & Co.
R. K. LeBlond Machine Tool Co.
J. J. McCabe.
Niles Tool Works Co.
Pond Machine Tool Co.
Putnam Machine Co.
S. W. Putnam Sons.
F. E. Reed Co.
Schumacher & Boye.
Warner & Swasey.

Screw Machines and Turret Lathes.

Bardons & Oliver.
Brown & Sharpe Mfg. Co.
Gisholt Machine Co.
Jones & Lamson Machine Co.
Spencer Automatic Screw Machine Co.
Warner & Swasey.

Planers.

American Tool Works Co.
Mark Flather Planer Co.
Pratt & Whitney Co.
Putnam Machine Tool Co.
Wm. Sellers & Co.

Shapers.

American Tool Works Co.
Fitchburg Machine Works.
Gould & Eberhardt.
Hendey Machine Co.
Morton Mfg. Co.
Niles Tool Works Co.

Horizontal and Vertical Milling Machines.

Becker-Brainard Milling Machine Co.
Brown & Sharpe Mfg. Co.

Horizontal and Vertical Boring Mills.

American Tool Works Co.
Baush Machine Tool Co.
Beaman & Smith Co.
Bement, Miles & Co.
Betts Machine Co.
Bullard Machine Tool Co.
Detrick & Harvey.
Niles Tool Works Co.
Pond Machine Tool Co.
Warner & Swasey.

Slotters.

Bement, Miles & Co.
New Haven Mfg. Co.

Grinding Machines.

Brown & Sharpe Mfg. Co.
Builders' Iron Foundry.
Gisholt Machine Co.
L. S. Heald & Son.
Landis Tool Co.
Wm. Sellers & Co.
Springfield Machine Tool Co.

Upright and Radial Drills.

American Tool Works Co.
Aurora Tool Works.
W. F. & J. Barnes Co.
Bement, Miles & Co.
Dreses Machine Tool Co.
New Haven Mfg. Co.
Niles Tool Works Co.
Prentice Bros. Co.
Prentiss Tool & Supply Co.

Miscellaneous.

Watson & Stillman Co.
D. Saunders' Sons.
D. E. Whiton Machine Co.
Baker Bros.
Hurlbut-Rogers Machine Co.
Acme Machinery Co.

* * *

To write on glass, says the *Mechanical World*, moisten the surface with strong vinegar, and write with an aluminium point. Small particles of the soft metal are left adhering to the glass, and the writing is fairly permanent.

PISTON HEADS AND PACKING RINGS.

PRACTICAL COMMENTS ON THE DESIGN AND OPERATION OF STEAM ENGINE PISTONS.

J. H. DUNBAR.

In at least two instances, the inventors of popular and valuable improvements in the field of steam engineering were mistaken as to the real cause of the action of their respective devices. Luck of this kind is so rare that patents in general are valueless; for the expected nearly always runs counter to the unexpected, forming a sort of immovable obstruction in the road to wealth from that direction.

The first of these mechanical "missfits" is the bent tube steam gage. The inventor of that useful boiler trimming supposed that, as there was greater area in the larger, or outside, diameter of the tube than on the inside, when the pressure was admitted, the tube would tend to straighten, for that reason. In other words, its tendency to straighten would be due to the difference in the area of its two sides.

If the inventor's theory had been correct, the hollow segment of a wheel, filled with water, and having a plug driven in the hole to produce a pressure of, say, 100 pounds per square inch, would slide away from the center, for there is a greater area on the larger diameter. Put wheels under it and it will go easier; and if it is wanted to go faster, drive the plug in further, and increase the pressure. To stop this automobile, we have only to pull out the plug; to back up, just swing the segment half way around, and drive the plug in again!

The first thing an auto of this kind would buck at would be perpetual motion, and the next would be Newton's third law of motion: "To every action there is an equal and opposite reaction." The real cause of the operation of the bent tube, when pressure is admitted to it, is due to its tendency to change its elliptical to a circular cross-section. If the tube is bent edgewise, and pressure admitted, its action is just the reverse to its action when bent sidewise. This discovery was made during the building of the St. Louis bridge in the early 70's. The second instance is less marked, and is not so susceptible of being proven or disproven, but the circumstantial evidence is so strong that there is no room for a doubt. I refer to the original Dunbar steam packing, in which the inventor had ports made to admit steam under the packing rings, to set them out to the cylinder. In the first place it ought not to get under; and in the second, there is no way of keeping it out. The packing was patented by Henry D. Dunbar, of Springfield, Mass., in 1860, and was at once adopted by many railway master mechanics and numerous stationary engine builders. While it is not as popular for locomotives as formerly, owing to the advent of the solid piston-head, it is still holding its own and is perhaps the best packing made, and that, too, without need of any change except the omission of the steam ports through the followers.

Figs. 1, 2 and 3 show this packing and are, in all important respects, copies of those forming a part of Mr. Dunbar's original patent. He took out another patent in 1865, which is the reason that the first one is referred to as the "original." The 1865 patent will be referred to later.

The original Dunbar packing is so well known that a detail description and drawing are thought to be unnecessary.

Admitting steam under the rings seems to have been a hobby of Mr. Dunbar's at that time, for he not only made provision for it to get in through holes in the follower shown in the sectional view, Fig. 3, and by the small dotted circles in Fig. 1, marked 0 in both figures, but also by ports cut in the side of the rings, as in Figs. 1 and 2 at 0'. He does not use these ports for general practice, nor say under what circumstances they would be required. An example will be

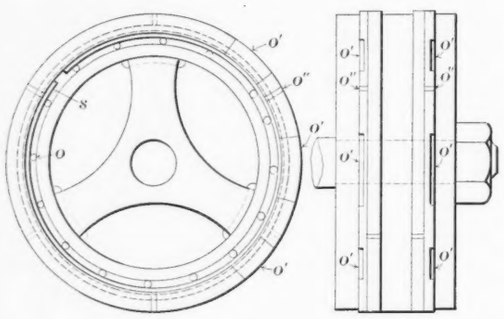


Fig. 1.

Fig. 2.

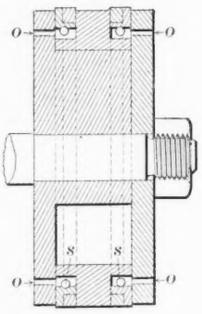
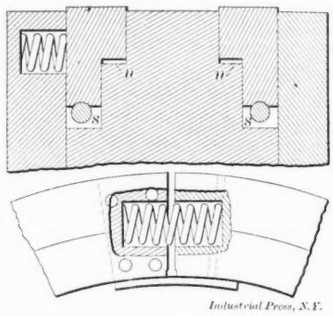


Fig. 3.



Figs. 5 and 6.

interesting, and will also make the subject clear as to what size port will be sufficient to keep cylinder pressure under the rings, assuming, of course, that these do not leak.

An engine 11 x 22 inches has a piston displacement of nearly 2,000 cubic inches, and steam is supplied through a 3-inch pipe. The packing rings are ¾ inch wide, and there is ½ inch space between them and the bottom of the groove, leaving a space to be filled with steam of, say, ten cubic inches. Now we want to maintain cylinder pressure in the space under the ring, and therefore the area of the hole through the follower should bear the same relation to that volume that the area of the steam pipe does to the volume of the piston's displacement. Representing the diameter of

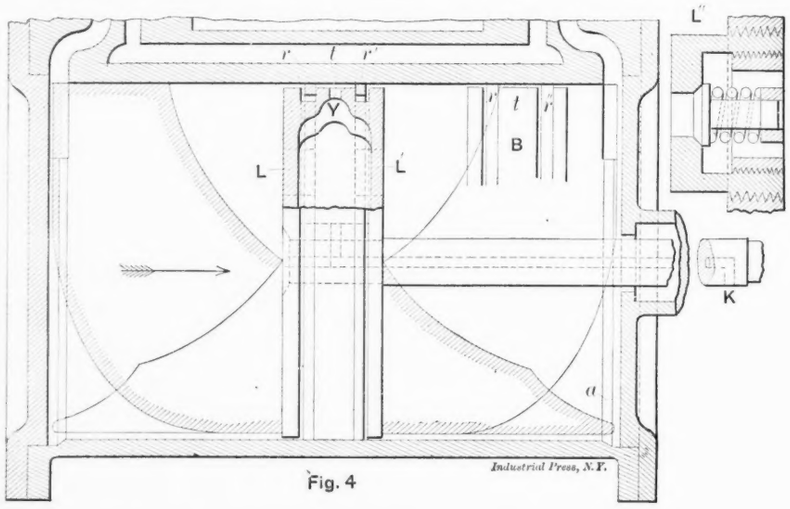


Fig. 4

the hole by x, and remembering that the area of circles varies as the square of their diameters, we have

$$2000 : 10 :: 3^2 : x^2;\ x^2 = \frac{3^2 \times 10}{2000} = .045,\ x^2 = \sqrt{.045} = .21$$

say ¼-inch hole.

As steam pipes are often twenty times their diameter in length, the cavity under the ring will come nearer having cylinder pressure than boiler pressure in the cylinder, for the length of the hole will not be more than three times its diameter, and no elbows.

It will be noted that in Figs. 2 and 3 the rings are put in the piston with the *L*, or angle ring, next to the followers, and the square ring next to the bull ring. Now, with the packing cut in the usual number of segments, the space at the joints, even when the rings are new, will be sufficient to equalize the pressures in the cylinder and that under the ring, if it can get past the follower to the joint. It is customary to put in Dunbar rings, as shown in Figs. 2 and 3, as there is less liability of the square ring dropping into the counterbore, if there is any chance for it to do so, and that is the only reason that I know of for putting them in in that way.

In engines where the rings travel over the counterbore, say 1-16 inch, and the piston strikes the cylinder heads before they can get into the port or counterbore—or if the engineer gets his piston travel right and then keeps it there—the rings should be reversed, i. e., the square one next to the follower; for then, if the ring is steam-tight in its groove, there is no passage to the cavity under it, it being understood, of course, that the holes *o* are omitted. The cross-section of the square ring is also usually less than that of the *L* ring, hence, if the square ring is placed next to the follower, there is less tendency of the rings to expand, owing to an end pressure at the joints.

So far, it has been assumed that the rings are tight in their grooves; but the first principle of a successful packing ring is that it shall automatically compensate for its own diametrical wear and also that of the cylinder, and to do this it must be free in the groove. The amount of freedom allowed by engine builders and others varies from "the thickness of tin" to a thousandth of an inch or less. Some railroad companies are careless in this respect, not only in regard to the allowance for "play," but they cut off snap rings and put them in without facing the edges. Such rings do not cost much, and are just worth their weight in pig iron; not that their lost motion in the groove amounts to much, but if a ring is to keep the live steam from mixing with the exhaust, one of the edges must make a joint with one side of its groove, and its circumference with the cylinder. Rings sawn off brass pipe would make very cheap safety valve seats, and would not leak as badly as a sawn-off packing ring, and there is about the same prospect of the valve getting tight, through use, as there is that a rough or untrue ring will "seat itself" while working.

I do not see why we cannot carry the safety valve comparison a little further to an advantage. For instance, if we allow a valve to lift freely .002 inch, we ought to expect it to blow, that is, if there is any steam in the boiler. And if a packing ring is five times the diameter of the valve, and has an equal "lift," we may expect the ring to blow five times as much steam, in the same time, if it can get through, which, of course, it cannot; for its amount of blow should be limited to the capacity of the space unoccupied in the groove, which ought not to be more than one cubic inch per inch in diameter of the ring. Other things being equal, the larger this groove-reservoir, the nearer constant will be the pressure in it, which is desirable, as the cylinder will wear more uniformly under such conditions. Before going further, we ought to consider the action of the packing rings in a two-ring piston, in an 18 x 24-inch engine, running 125 R. P. M., equivalent to 500 feet of piston speed. At this speed, the average inertia of the piston or of any part attached to it, at the end of the stroke, is five times the weight of the rings. Assuming a packing ring to weigh 10 pounds, its momentum, when the engine is on the centers, will be 50 pounds. A part of this force will be absorbed by friction between the ring and the cylinder, and the rest will push on the piston, perhaps not directly, but through a film of steam between it and the side of the groove.

Besides the ring being influenced by its friction against the cylinder, and its inertia, there will be an edge pressure on it, and this combination of forces will keep it alternating from side to side of the groove, with each stroke of the piston. I have never seen a set of old packing taken out that did not show unmistakable signs of side wear, and in fact, in packing from some small, high-speed engines the rings were reduced more in width than in thickness. The only exception to the above is when the rings had been fitted too snugly in the grooves or when too liberal an allowance of poor cylinder oil was used, when they were found to be stuck solid in the head, and could only be encouraged to come out when a cold chisel was driven under them. This happens most frequently with gas engines, where the "mixture" mixes with, and solidifies, the packing rings and piston head.

We now follow the piston through a stroke, and note the action of the packing rings, remembering that anything loose in the piston, as, for instance, a piece of broken packing ring, will "hammer" at mid-stroke, or near it. For the piston must stop in less than ⅛ of a second, from a speed of 784 feet per minute, and in a distance of one foot. The loose piece, on the other hand, tends to travel right along at the 784 gait, and is only prevented from doing so by getting up against some part of the piston, where it stays; while the crank is going over the center and brings the piston to mid-stroke, traveling in the opposite direction, and the piece and the piston travel together over the other center, and so on.

With the engine running at full speed, we catch the piston at mid-stroke, when the packing rings, *r* and *r'* will be against the inside edges of the grooves, as shown in Fig. 4. The diagrams drawn in the cylinder represent the pressure on it, and the arrow its direction of motion. The shaded diagram is, of course, for the head end. As the rings will leak a little, there will be a pressure of steam or water, or perhaps both, in the space between the rings marked *t*, equal to about half the average pressure on the piston. This pressure will tend to force the rings to the opposite sides of the grooves, but the outside steam on the edge of ring *r*, and its inertia, will more than equal the frictional resistance between it and the cylinder, and will therefore keep to that side of the groove to the end of the stroke. There is nothing but the cylinder friction and the exhaust pressure on its edge to keep ring *r'* to the inside of the groove. So by the time the piston gets to the position marked *B*, the pressure between the rings, in space *t*, and its momentum, will force the ring ahead to the other side, as shown at *r''*, where it will stay till it gets closer to the end of the stroke. Then the cushion pressure will force it back to the other side of the groove again, where it will remain till the piston again reaches position *B*, when traveling from the head end of the cylinder. The action of ring *r* is similar, but at the other end of the stroke. I believe that this accounts for the slight double click one sometimes hears as an engine goes over the centers. Of course there is a lot of speculation in regard to how packing rings pack, and theory in regard to it would be interminable; but while I am "shutting" off, will say that rings, as usually made, and especially for large engines running at a high rotative speed, ought not to take five times their weight to move them in the cylinder, and therefore the piston will push the rings through the greater part of the stroke, and the rings will push on the piston during the balance. There is no pressure under the ring on the exhaust side of the piston to increase the cylinder friction.

The pressure between the rings, in space *t*, is objectionable on account of putting a steam load on the piston which, I think, is often much greater than its weight; and to get rid of it I propose to drill a hole down through the piston, as at *Y*, and communicate with a hole through the center of the piston rod to an outlet near the cross-head, as at *K*. Another way to relieve the pressure in *t* would be to put in valves, as shown in an enlarged view at *L''* in the sides of the piston marked *L* and *L'*.

Figs. 5 and 6 show Mr. Dunbar's patent of 1865. It will be seen by reference to Fig. 5 that he does not use his break-joint ring of 1860, which made him famous, but one of deep, angle-shaped section, cut in segments. His reason for cutting them into several sections is as follows: "The object attained by cutting the ring into a number of parts or segments is the superior facility with which a ring so constructed adapts itself to any irregularities of the interior surface of the cylinder. An elastic ring having only one cut will conform to simple inequalities of size, or interior diameter, so long as the surface remains truly cylindrical; but

such a ring will not conform to those other irregularities which are simply of surface and do not extend entirely around the cylinder." It will appear from the above that they made their cylinders more or less polygonal, in 1865. Probably cylinders wore that way at that time, and Mr. Dunbar's ring was intended to round them; at all events he allows ample endwise motion of the rings, to prevent wearing ridges in the cylinder. By putting a spring between the ends at one joint, he keeps the rest closed, and covers the break at the spring

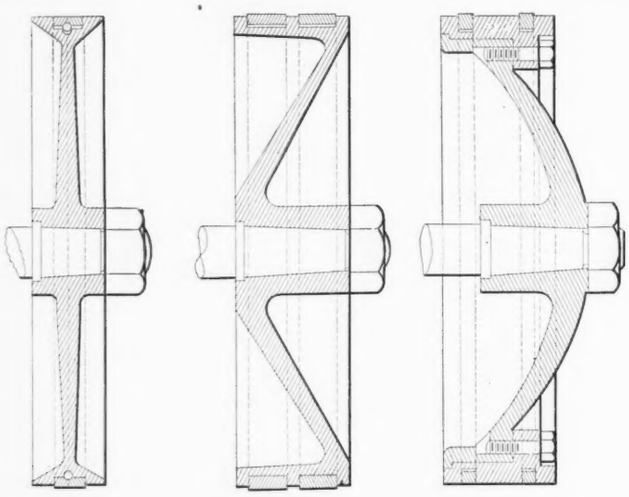


Fig. 7. Fig. 8. Fig. 9.

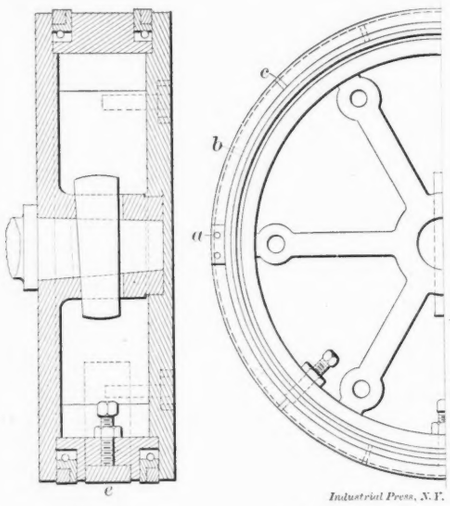


Fig. 10. Fig. 11.

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with a thin angle piece riveted on, as shown in Fig. 6. He also puts in a wire spring ring to hold the ring to the cylinder.

The off-set in the rings, shown in Fig. 5, is to prevent the steam from setting them out to the cylinder with more pressure than is required. This he accomplishes by letting the steam get under the ring in the space *s*, but not at *n*. The friction between the ring and groove, on the off-set side, counteracts as much of the radial pressure in the space *s* as is desirable. I put in the spring in this figure to represent a great many schemes that are intended to produce

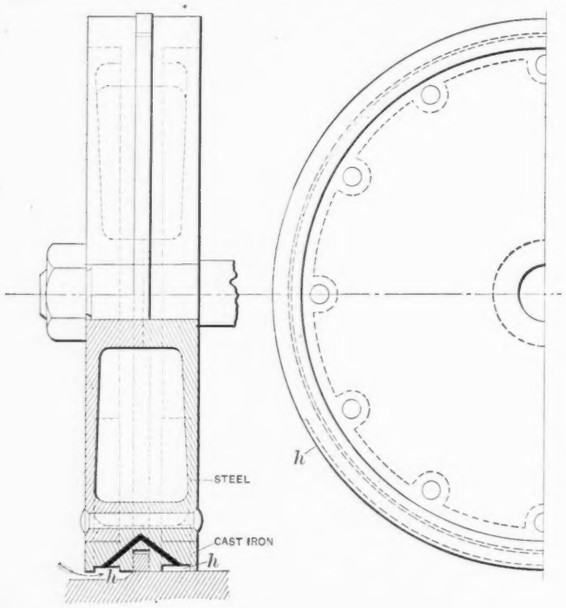

Fig. 12.

groove-friction, and prevent side hammer; but so far as I am able to find out, the ring, under such conditions, packs the groove and not the cylinder, and it is essentially the same as making the rings too tight a fit in the grooves, with the results which had been stated above.

Figs. 7, 8 and 9 show types of steel pistons for locomotives. As steel and cast iron do not wear as well together as cast iron on cast iron, the piston head must not be allowed to touch the cylinder. In Figs. 7 and 8 the head is carried on the cast-iron packing rings, which are kept lined up between the bottom of the groove and ring, as the latter wears away. There is a spring wire ring in Fig. 7 which tends to spread them apart and also gives them a radial pressure against the cylinder. This head represents a "bit" of English practice. Figs. 8 and 9 are American. A peculiarity of Fig. 9 is that it has a cast-iron ring bolted to the steel center, which makes it O. K. in regard to its wearing qualities. The awkward shape of these two pistons give them a gingerbread appearance, and the scalloped cylinder heads they require to match them, together with their large radiating and conducting surface, will bar them from being popular, especially for stationary engines.

Figs. 10 and 11 show a section and half-elevation, respectively, of a piston for stationary engines, with the original Dunbar packing ring. The head is of the built-up type with a bull ring, having an adjustable brass shoe *e* in the bottom of it to carry the weight. There is nothing wrong with this design, if the work is first class and properly cared for.

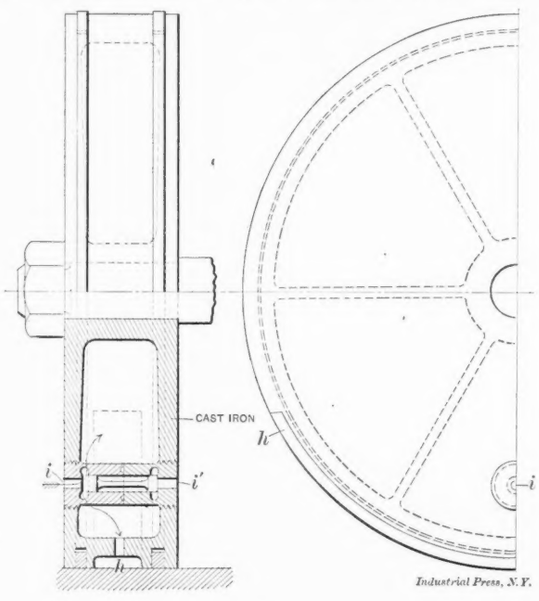

Fig. 13.

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All bolts should be made of BB iron, a snug fit in the tapped holes, but not overstrained in tightening. There is no place where horse sense is more valuable than when using a wrench on bolts and nuts. If a bolt is once pulled beyond its elastic limit, it is liable to break very easily at any time, and without a second provocation. The sketches, 10 and 11, show a good way to make piston and cylinder head bolts.

The remaining two figures, 12 and 13, suggest how to

keep pistons off the bottom of the cylinder. The scheme is to admit steam to a cavity in bottom of the piston head. For pistons made for one ring, there is a cavity on each side of it, with a hole connecting them, so steam can flow from one to the other. With the piston at the head end of the stroke, the steam enters the cavity, as shown by the arrow, and adds a fresh supply to the cavity on the exhaust side of the piston, through the angling hole up and down over the packing ring, if any is needed. If not needed, it flows in anyhow and lifts the head, and the surplus leaks out. It will not be necessary to provide any extra head room in the cylinder for the piston to lift in, for the steam that can get through, say a ⅛-inch hole, will not perceptibly elevate a piston having a cavity of 30-inch area, nor will the leakage be appreciable. When the piston passes the counterbore, the direct supply of steam is cut off from both cavities, but it is believed that steam will leak in from one side faster than it condenses and leaks out on the exhaust side. If a reservoir to store steam is required, the cavities can be connected direct to the interior of the piston, and the hole around the packing ring omitted.

We now come to the two-ring piston, and why two rings are used at once is a mystery to me. It is like carrying an extra shoe for fear of an accident that would compel one to come home on one leg, or in some semi-barefoot condition. If one packing ring is practically steam-tight, and they can be made that way, there is no need to put in a whole lot, to wear out the cylinder and use up lubricant. However, the multiple ringed piston has been here a long time, and perhaps has come to stay; so I have adapted my scheme to it, but have had to put in a valve in doing so. Steam enters at each side of the piston, at *i*, as shown by the arrows, and at *i'* into the cored-out space in the piston head, then down to the cavity between the rings. The steam pressure used, the point of cut-off, the weight of the piston, and the area of the cavity, would all have to be taken into consideration, in determining the size of the holes for the inlet; but comparatively small holes will suffice.

* * *

PATTERNS WITH BRANCHES.

GEOMETRY APPLIED TO PRACTICAL PATTERN MAKING.

I. McKim Chase.

Fitting branches to patterns, such as pipes and valves, by the usual cut-and-try method is tedious and consumes unnecessary time, especially when the body to which the branch is to be fitted is of some peculiar form. By preparing paper patterns of the line of juncture of the two parts, and marking this line off on the branch, the work is more skilfully performed and the job expedited. Several different forms of preparing these patterns are here elucidated. When the principles involved in these problems are mastered, they can be applied to a wide range of work.

When the body and branch are of equal and uniform diameter it is simply necessary to first cut the end of the branch on either side at 45 degrees with the center line, as at *A* in Fig. 1. The line so produced on the circumference of this branch will be that of its juncture with the body and when the branch is cut across to this line, it will fit the body if the work is accurately performed.

B, Fig. 1, presents a problem not so simple as the previous one. Here the branch is smaller in diameter than the body to which it is to be fitted, and a paper pattern is to be made to mark off the line of juncture. Lay down a plan and a section of one-half of the body and branch, as *a* and *b*; divide the semi-circumference of the branch *a* into any number of equal parts, so as to have a line in the center, and number the intersections. From these intersections project lines intersecting the curve of the body *b*. Now tack down a piece of suitable paper, *c*, in the position shown, and on it draw two parallel lines, as 0 and 6, whose distance apart is equal to the circumference of half the branch *a*. Divide this distance into the same number of parts as that of *a*, and draw lines parallel with the outside lines. From the intersections of the lines from branch *a* with the body, project lines intersecting the lines on the paper *c* with corresponding numbers. A curve drawn through these intersections will give the developed curve of juncture of the branch with the body and as in this case both halves of branch are alike, the pattern will answer for both. To arrive at this developed curve it is not absolutely necessary to lay down the plan view, when both the branch and body are cylindrical and are at right angles; but when it is desired to show the projected curve of the juncture, the plan view is necessary, and the intersections for it are obtained by projecting from the sectional views, *a* and *b*, to ordinates with corresponding numbers on the plan.

In Fig. 2 is shown a branch fitted diagonally to the body of the pattern. To obtain the developed curve in this case the method to be pursued is similar to the previous problem. The plan and sectional views are to be made and divided as previously explained and the projected curve of the juncture of the body and branch obtained by projecting from the intersections on the section *b*, of the body to ordinates correspondingly numbered on the plan view of the branch. The developed curve of the juncture is then obtained by placing the paper alongside of the branch and projecting from the latter. Lay off on the paper two lines parallel with each other and with the axis of the branch make the distance apart of the lines equal to the circumference of one-half of the

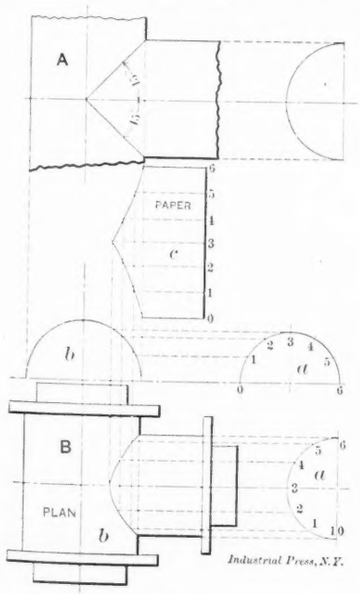

Fig. 1.

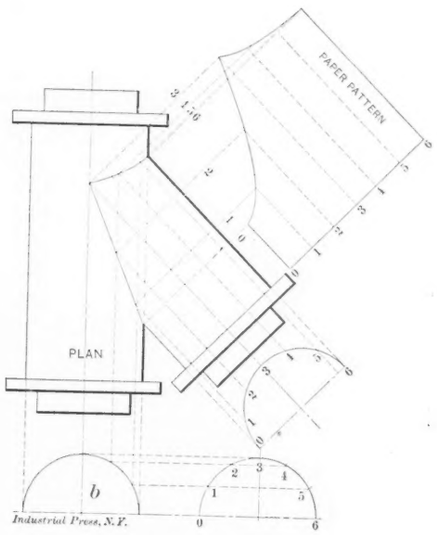

Fig. 2.

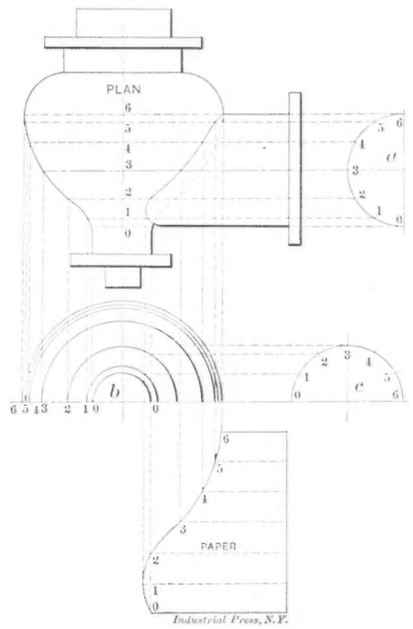

Fig. 3.

branch, and divide this distance into the same number of equal parts as that of the branch. From the intersections which produced the projected curve of juncture on the plan as obtained project at right angles to the axis of the branch to the ordinates on the paper, intersecting those correspondingly numbered. A curve drawn through these last intersections will give the developed curve of juncture.

Fig. 3 illustrates the body of a pattern which is not cylindrical, but which has a cylindrical branch fitted to it. With many workmen, at first sight, it would seem a very difficult problem to work out the developed curve of juncture of branch with body in this case, but if the previous examples have been studied and mastered, it will be found quite an easy matter to do so.

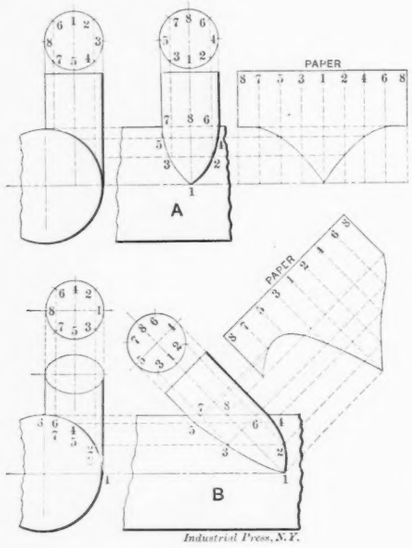

Fig. 4.

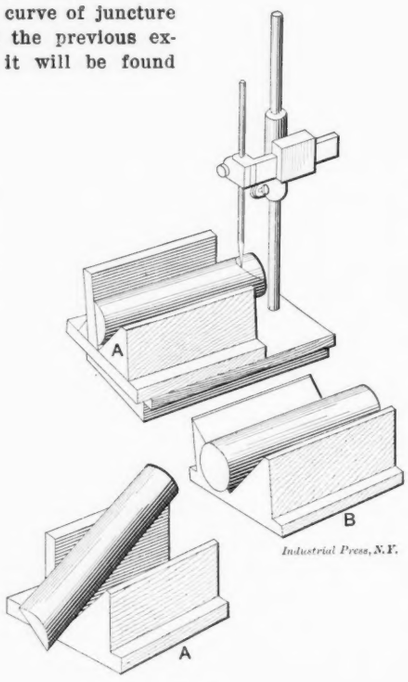

Fig. 5.

The plan view is to be first laid down, or so much of it as is covered by the branch. Draw a section of one-half of the branch in the position shown by *a*, and divide its circumference as in previous examples. Through these intersections draw lines parallel with the axis of the branch, extending across the body, thus cutting the body into as many sections as lines. These sections of half the body are to be drawn below the body in the position shown by *b*, and numbered correspondingly to those on the body. A section of the branch is drawn in the position shown by *c*, and the half circumference divided the same as that for the plan view. From these intersections lines are drawn intersecting the sections of the body correspondingly numbered. From these last intersections, both the developed and projected curve of juncture is obtained by following the method of doing so explained in the previous examples.

It is sometimes required to fit a branch or boss on a body away from the center line of the latter. Fig. 4 shows two such cases. In the upper view *A*, the branch is at right angles to the body and to one side of its center. To obtain the developed curve of the juncture of the branch with the body in this case lay down the branch and so much of the body as necessary in both end and side views. Draw end views of the branch and divide them into equal parts; from these intersections project lines parallel with the axis of the branch and intersecting the body. Number these ordinates correspondingly. Tack down the paper in the position shown and draw two lines parallel with each other and with the axis of the branch; make the distance apart of the two lines equal to the circumference of the branch. Divide this distance into the same number of equal parts as the end view of the branch and draw ordinates parallel with the outside lines. Number the ordinates to correspond with those projected from the end view of the branch. From the intersection of the ordinates on the branch with the body project lines intersecting the ordinates correspondingly numbered on the side view and on the paper; a curve drawn through these intersections on the side view will give the projected, and a curve drawn through the intersections on the paper will give the developed curve of the juncture of the branch with the body.

The lower view, *B*, shows the branch located to one side of the center of the body as in the previous case viewing the body on the end; but viewing the body on the side, the axis of the branch is inclined to that of the body.

To obtain the projected curves of juncture in this case draw the two views as before and draw ordinates on the branch projected from intersections on its end view. From the intersections of these ordinates with the body on the latter's end view, project lines intersecting the ordinates, correspondingly numbered on the side view. A curve drawn through these latter intersections will give the projected curve of juncture of branch with body. To obtain the developed curve tack down the paper in the position shown and upon it draw two lines parallel with each other, and with the axis of the branch on the side view, make the distance between the lines equal to circumference of the branch. Divide this distance into the same number of equal parts as the branch and draw ordinates parallel with the two end lines. Number the ordinates to correspond with those on the branch. From the intersections of the ordinates on the branch with the body, as shown in the side view, project lines at right angles with the axis of the branch intersecting ordinates correspondingly numbered on the paper. A curve drawn through these last intersections will give the developed curve of the juncture of the branch with the body.

Where there is frequent occasion for fitting branches when making plain patterns, such as pipes, etc., a device like that shown in Fig. 5 will be found a great advantage. It consists chiefly of a base plate having a true surface with a spindle fixed near one end and perpendicular to the true surface of the plate; also a head which has both a sliding and revolving motion on the spindle. The sliding head carries a radius bar set at right angles to the axis of the spindle. The radius bar is adjustable to suit different radii and one end is provided with a scriber held in a clamp bearing so that it can be adjusted to suit different diameters of branches.

A and *B* are cradles to which the work is secured by wood screws while being operated upon. The cradles can be made of wood, but are much better when made of metal and finished accurately. There should be a center line scribed on the surface of the base plate parallel with its sides and intersecting the axis of the spindle to serve as a datum line for setting the cradles when the work is to be marked. The cradle *A*, is intended for parted work and *B* for work not parted.

The device is equally handy whether the boss or branch is to set at right angles to the body of the pattern or at any other angle, or whether it is to set away from the center line of the body. In the former case it is only necessary to secure the work at the desired angle in the cradle, or in the case of it being set to one side of the center line of the body of the pattern to set the cradle accordingly on the base plate while the curve is being scribed on the work.

After the work is scribed, which will be on the upper side as it sets in the cradle, the latter can be taken to the band saw and the work cut to the line. If the entire operation has been carefully and accurately done the branch will need very little further fitting to allow it to be secured in the place intended for it.

* * *

London is now awakening to the "possibilities" of liquid air. At a recent automobile show an English liquid air carriage was shown, which is reported to have the distinctive advantage over other automobiles of having "run considerable distance with complete success."

TRANSMISSION ROPE SPLICING.*

DIRECTIONS FOR MAKING A SPLICE CORRECTLY.

If the researches of our engineer have developed nothing else, they have shown beyond all question that at least 95 per cent of the "troubles" complained of in rope drives are directly caused by bad splicing, notwithstanding that to make a proper transmission splice is a very simple operation, the idea having once been grasped.

The essential points in a transmission splice are: First, that its diameter be absolutely the same as that of the original

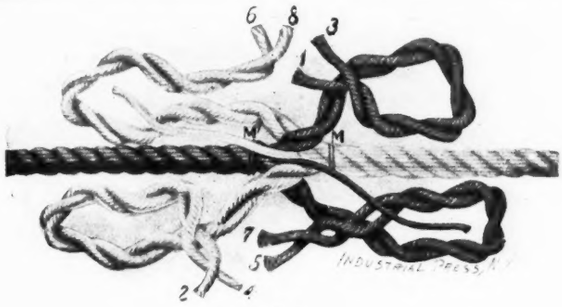

Fig. 1.

rope; second, that it be smooth and free from lumps; third, that the original lay of strands and yarns be disturbed as little as possible; and, fourth, that where the several strands are rejoined, each fastening or "tuck" should be made in such manner as to prevent its wearing away and the rope unstranding.

There are many different splices now in use, but after a careful consideration of each we are convinced that all the

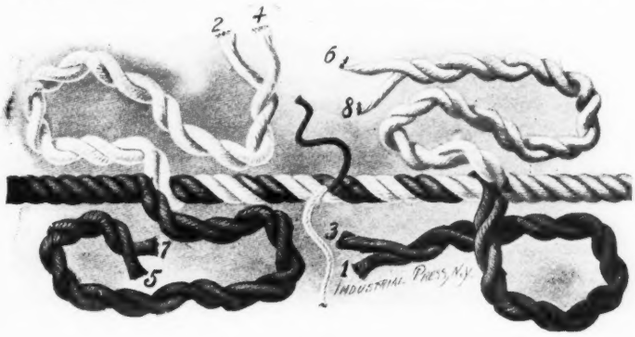

Fig. 2.

above features are combined only in what is called the English transmission splice, and experience has proved it the best splice now known.

In describing this, we take for our example a four-strand rope, 1¾ inches diameter, as spliced on sheaves in the Multiple System.

The rope is first placed around sheaves, and, with a tackle, stretched and hauled taut; the ends should pass each other from six to seven feet, the passing point being marked with twine on each rope. The rope is then slipped from sheaves and allowed to rest on shafts, to give sufficient slack for making splice.

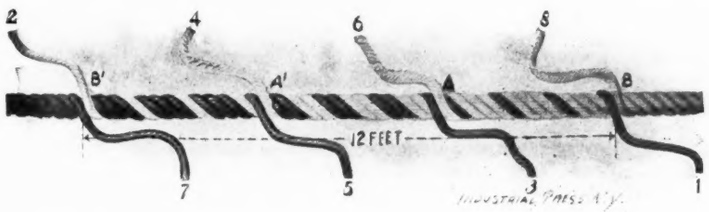

Fig. 3.

Unlay the strands in pairs as far back as the twines, *M*, *M'*, crotch the four pairs of strands thus opened, Fig. 1, cores having been drawn out together on the upper side.

* By permission, from "A Little Blue Book on Rope Transmission," published by the American Mfg. Co., 63-65 Wall Street, New York.

Then, having removed marking twine *M*, unlay the two strands 6 and 8, still in pairs, back a distance of two feet, to *A*, Fig. 2; the strands 1 and 3, also in pairs, being carefully laid in their place.

Next unlay the strands 5 and 7 in pairs, to *A'*, replacing them as before with 2 and 4. The rope is now as shown in Fig. 2.

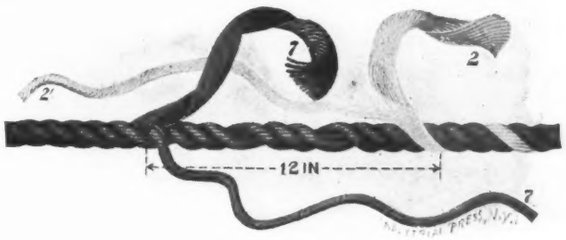

Fig. 4.

The pair of strands 6 and 8 are now separated, and 8 unlaid four feet back, to *B*, a distance of six feet from center, strand 6 being left at *A*, Fig. 3.

The pair of strands 1 and 3 having been separated, 3 is left at *A*, as companion for 6, strand 1 being carefully laid in place of strand 8 until they meet at point *B*.

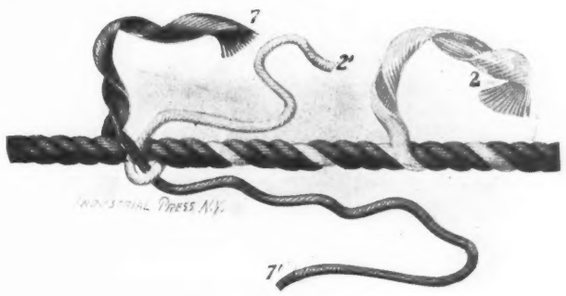

Fig. 5.

The two pairs of strands 2-4 and 5-7 are now separated and laid in the same manner, every care being taken, while thus putting the rope together, that original twist and lay of strand is maintained.

The protruding cores are now cut off so that the ends, when pushed back in rope, butt together.

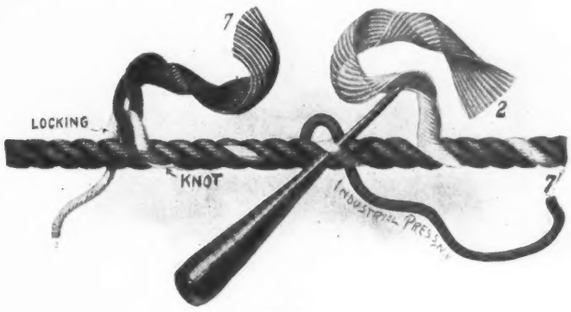

Fig. 6.

The rope now appears as shown in Fig. 3, and after the eight strands have been cut to convenient working lengths (about two feet), the companion strands are ready to be fastened together and "tucked."

The operation is described for strands 2 and 7, the method being identical for the other three pairs.

Unlay 2 and 7 for about 12 to 14 inches; divide each strand in half by removing its cover yarns (see Fig. 4); whip with twine the ends of interior yarns 2' and 7'; then, leaving cover 2, relay 2' until near 7 and 7', here join with simple knot 2' and 7', Fig. 5.

Divide cover yarns 7, and pass 2' through them, continuing on through the rope *under* the two adjacent strands, avoiding the core, thus locking 2', Fig. 6. *In no event pass 2' over these or any other strands.*

Half strand 7' must now be taken care of; at the right of the

knot made with 2′ and 7′, 2′ is slightly raised with a marlin spike, and 7′ passed or tucked around it two or three times, these two half strands forming in this way a whole strand. Half-strand 7′ is tucked until cover 2 is reached, whose yarns are divided and 7′ passed through them and drawn under the two adjacent strands, forming again the lock. The strand ends at both locks are now cut off, leaving about 2 inches, so that the yarns may draw slightly without unlocking. This completes the joining of one pair of strands (Fig. 7). The three remaining pairs of strands are joined in the same manner.

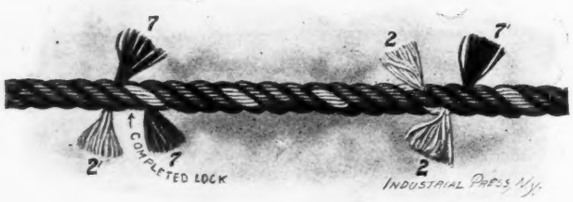

Fig. 7.

After the rope has been in service a few days, the projecting ends at locks wear away, and if tucks have been made carefully, and original twist of yarns preserved, the diameter of the rope will not be increased, nor can the splice be located when rope is in motion.

* * *

CHAMFERING BEVEL GEARS—TURRET LATHE TOOL HOLDER.

The orthodox method of making bevel gears requires that the outer ends of the teeth be chamfered off so as to be at right angles to the line passing through the intersection of the pitch circles and the intersection of the axes of the two gears. Thus in Fig. 1 the edges *de* of *A* and *ef* of *B* are

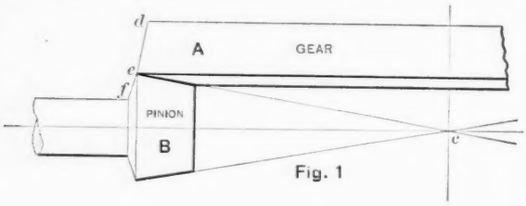

Fig. 1

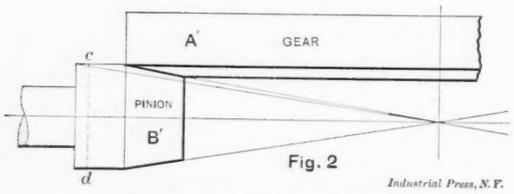

Fig. 2

Industrial Press, N.Y.

Two Methods of Finishing Bevel Gear Blanks.

chamfered so as to be square with *ec*. There are, however, cases where this practice is not followed, for the very good reason that doing so would cause the loss of strength that could ill be spared. Such a case is found in the construction of heavy geared chucks, such as used on the boring mills made by the Bullard Machine Tool Co. The teeth of the

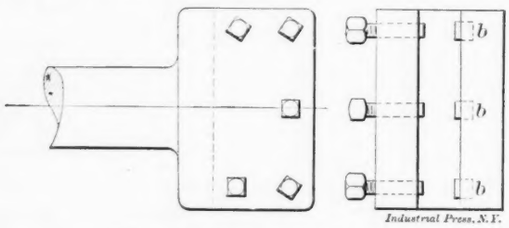

Fig. 3. Tool Holder for Turret Lathe

pinions and the circular racks, are subjected to very severe stresses by careless operators when tightening work held in the jaws. The teeth of the pinions are more likely to fail than those of the circular rack, if made of the ordinary form, but when made as indicated in Fig. 2 the teeth are greatly reinforced. The bottom of the tooth spaces in the pinion extend to, say, the dotted line *cd*, thus adding possibly 50 per cent to the cross section of the tooth to resist fracture. In addition to being stronger, this construction is simpler and cheaper to manufacture than the time-honored form.

Another good scheme in machine tool construction observed in the shops of the same firm, is the manner of making the tool holders for turret lathes. While it is by no means new, it will no doubt be of interest to many. As is well known, the ordinary plan of making a tool holder for a turret lathe or boring mill, like that shown in Fig. 3, is to face the bottom of the slot opposite the setscrews with a plate of hardened steel, checked or corrugated on top to prevent the tools slipping. The tool holder shown is so designed that this expensive and not very satisfactory construction is avoided by the use of a substitute, which is cheaper and perhaps better. The holes for the set-screws are continued part way through the opposite jaw of the tool holder. The holes are counterbored out with a special tool for the hardened steel buttons or plugs *b b b*, etc., which are checked on top. The result of this construction is that the bearing of the tool is always in direct line with the thrust of the setscrews.

* * *

RAPID AND SLOW COMBUSTION.

The only distinction between the explosion of dynamite and the burning of a candle or a fire in a stove is the rate at which the combustion takes place. The distinction is about the same in degree as between the burning of coal and the rusting of iron. All are examples of combustion. The union of the oxygen of the air and the carbon of the coal requires a few minutes, while the destruction of the iron by oxidation may require weeks or even years. In the case of dynamite it is a matter of seconds or of the fraction of a second. The more rapidly combustion occurs, the more nearly is the explosive effect reached, although the most violent explosions do not necessarily take place when combustion is most rapid. Oftentimes a powder explosion is incomplete because the explosion takes place before there is time for all the powder to burn and part of it is blown away untouched. This accounts for the powder wounds so common among those who play with guns that they "didn't know were loaded." The modern smokeless powder is more slow burning and the combustion is nearly complete before the charge leaves the gun. The chief advances made in the manufacture of powder have come through the ability to control the time required to complete its combustion; or in other words, to control the time of its explosion. Powder may easily be made which will burn like a piece of pine wood.

The explosive shell has not until recently been entirely successful in warfare, owing to the difficulty in controlling the time at which the powder or other explosive mixture in the shell would explode. If a high explosive is so sensitive that it will explode on striking armor, it will generally explode in the gun from shock of discharge. On the other hand, if it is de-sensitized so that it will not explode in the gun, it will generally not explode with certainty on striking armor. The U. S. Ordnance Department has succeeded in getting around the difficulty by de-sensitizing the explosive so that it will not explode in the gun, and by developing a fuse which will detonate the explosive on striking the target, or in passing through it; the fuse being so arranged that it can be exploded at any given time within very narrow limits. This is considered to be one of the most important modern developments, and it is believed that no other country has solved the problem to this extent.

* * *

In using a flux, as is necessary when welding steel or iron and steel, it is oftentimes difficult to keep the flux in place on account of its quickly melting and running off the weld. M. J. Lafitte, Paris, France, has devised a flux consisting of a borax mixture in which is incorporated a fine wire netting to hold it together. It is rolled out in thin sheets and divided into squares which are easily broken apart for use. Tests of steel specimens welded in the French government works show a remarkably high efficiency of the welds. This is due to the high protective power of the flux which prevents the formation of oxide on the surface of the welds.

THE NATIONAL BUREAU OF STANDARDS.

A STATEMENT BY THE DIRECTOR, DR. S. W. STRATTON.

Dr. S. W. Stratton, the director of the new National Bureau of Standards, recently lectured before the Engineers' Club of Philadelphia, outlining the work the bureau is to undertake. He dwelt at length upon the lack of uniformity in this country of standards of any kind and of the difficulty in determining whether measures and weights supplied by different firms agreed exactly with one another, and then explained the functions of the bureau of standards, as organized by the United States Government. The following abstract is from Dr. Stratton's lecture:

It is only very recently that provisions made by Congress covered even the common measures of weight, length, and capacity. The set of standards furnished each state consisted originally of the most ordinary standards of length, weight, and capacity. Later, a few metric standards were added to these, but in few instances have the states provided facilities for the proper comparison and use of these standards by the general public. In some states the standards have been destroyed or lost track of, and we find little legislation pertaining to weights and measures other than to fix the number of pounds to the bushel, to be used in measuring grain and other products. An investigation carried on last summer by a government official disclosed a condition of affairs in regard to the common weights and measures of the country that would hardly bear publication. The duties of state and city sealers should include the testing of water and gas meters, and perhaps eventually electric meters, but certainly all of the standards and measuring instruments in common use by the people. And it is the duty of the general government to provide such officers with suitable standards, measuring instruments, and instructions governing their use. As it has been, the general public, scientific institutions, and other vast interests were unprovided for, even in the most common cases. * * * The manufacture of physical, astronomical, chemical, and other scientific apparatus has been confined almost exclusively to foreign countries; but this industry is growing in the United States at a rate which will soon place our productions on an equality with those of any other country. Our manufacturers of such apparatus have shown that they can compete with the foreign products in workmanship and design. They have, however, been placed at a great disadvantage owing to the fact that this government has not provided them with the necessary standardizing facilities. German and English manufacturers furnish official certificates with their apparatus, and the value of such certificates is so well recognized that we find our own manufacturers quoting prices on their apparatus which has been verified in the institutions of foreign governments.

It was this condition of affairs that led Congress to enact a law on March 3, 1901, establishing the National Bureau of Standards, the function of which includes the custody of the official standards, and comparison of all standards used in scientific investigations, engineering, manufacturing, commerce, and in educational institutions; with the standards adopted or recognized by the government, and the construction, when necessary, of standards, their multiples and subdivisions, the testing of standard measuring apparatus, and the solution of problems which arise in connection with standards. It is also authorized to make physical and chemical researches for the purpose of determining physical constants and the properties of materials when such data are of great importance to scientific or manufacturing interests. The bureau is authorized to exercise its functions for the departments of the government, for any state or municipality within the United States, and any scientific society, educational institution, firm, corporation, or individual engaged in manufacturing or other pursuits requiring the use of standards or standard measuring instruments.

A suitable site has been purchased by the government adjacent to the picturesque national reservation known as Rock Creek Park, in the northern suburbs of Washington, a locality free from mechanical and electrical disturbances. Plans are being prepared for a physical laboratory, which will be equipped with apparatus and conveniences for carrying on investigations and testing standards and measuring instruments of all kinds; also a smaller building, to be known as a mechanical laboratory, which will contain the power and general electrical machinery, the instrument shop, refrigerating plant, storage batteries, and dynamos for experimental purposes, and laboratories for electrical measurements requiring heavy currents.

The scientific work of the bureau will be under the immediate supervision of a director, assisted by a corps of physicists and chemists designated as laboratory assistants, assistant physicists, or chemists. These men have been carefully selected by civil-service examinations prepared with reference to the kind of work to be undertaken. No attempt has been made by politicians or others to influence the appointments in the bureau, and the bureau, once established upon this basis, will, it is believed, be free from political influence. The Senators and Representatives who were instrumental in the passage of the bill would first of all resent any interference with the selection of these men upon any other basis than merit. To guard against any possible contingency of this kind, the law provides for a Visiting Committee composed of prominent specialists, each serving for a period of five years. The members of the present Visiting Committee were appointed to serve for periods of one, two, three, four, and five years, but their successors will all be appointed for the full period. The committee consists of President Ira Remsen, of Johns Hopkins University; President H. S. Pritchett, of the Massachusetts Institute of Technology; Professor Elihu Thomson, electrical engineer; Professor Edward L. Nichols, professor of Physics in Cornell University; and Mr. Albert Ladd Colby, metallurgical engineer of the Bethlehem Steel Company. This committee, composed of men of world-wide reputation, will be consulted in all matters pertaining to the organization of the bureau.

The value of such an institution has been clearly demonstrated by nearly every government of Europe. England has established a Standards Department of the Board of Trade, also the Electrical Standardizing Laboratory; and recently a Physical Laboratory. Kew Observatory, an institution famous for its testing of meteorological instruments, has also become a government institution. Germany has established the Normal Aichungs Commission, with its laboratories and facilities for handling commercial weights and measures; and in 1887 the Physikalisch-Technische Reichsanstalt, an institution costing more than a million dollars, which makes provision for scientific standards and investigations. It has been frequently said that this institution more than pays for itself annually in the assistance it gives to German engineers, manufacturers, and scientists. The scientific work of our own government has received great benefit from this institution during recent years. At the hearing before the House Committee on Coinage, Weights, and Measures, in reference to the Bureau of Standards bill, the secretary of the Treasury presented letters from every scientific bureau in the government, stating that they were compelled to go to this institution for certain standards. * * * It is hoped that this bureau will in time become something far more important and comprehensive than a mere standardizing institution. The scientific and engineering laboratories of our country are carrying on researches and investigations which are equal in value and importance to those of any other country. It is not to be expected that an engineer or manufacturer can keep in touch with the scientific literature of this and other countries, and the scientist is too frequently unconcerned or prevented by a lack of time from the consideration of the practical applications of scientific work. There is no reason why this bureau should not eventually be a bureau of information where manufacturers and engineers may go for assistance and information along scientific lines. The progress of manufacturing and of many commercial industries follows very closely the scientific development of the country. The government expends over a million dollars annually in maintaining an elaborate system of agriculture experiment stations throughout the country, in order that an agriculturist may have the benefit of scientific investigation. Why should not the manufacturer be assisted in the same way?

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We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

JULY, 1902.

NET CIRCULATION FOR JUNE,* 1902,—28,297 COPIES.

PROSPECTS FOR THE NEW YORK AND OTHER NAVY YARDS.

There are so many creditable shop buildings in this country having wonderfully complete machine tool equipments, that it would be impossible to designate any one or even a few of them as the "finest in the country." It is safe to say, however, that few, if any, shops are actually finer or more complete in their appointments than those of the Steam Engineering Department of the New York Navy Yard, which we illustrate in this number. It is very evident to a visitor at the navy yard that it was the intention of the government to equip this plant for any demands that might be made upon it in the future in the way of constructive work.

Generally the construction of a machine shop is a matter of evolution. Equipment and buildings are added as the increase of the business demands it, and when the time comes to erect a new plant it is made equal to the requirements at that time, with provision for additions to accommodate future growth. At the New York Navy Yard, however, the plant has been designed to meet future rather than the present needs, and in consequence a great many expensive tools are now standing idle or are used only occasionally, when required for repair work. No industrial firm could afford to do business in this way, and it is doubtful if the government, even, would have installed so expensive and complete an outfit for repair work alone.

The probabilities are that in the near future some of the warships authorized annually by Congress will be built in the various navy yards and the New York yard is so complete that marine machinery for such vessels could be constructed economically in the Steam Engineering shops without the addition of a single new machine tool. As most of our readers are aware, a bill providing for the construction of one vessel of the navy at each of the leading government yards has recently passed the lower house of Congress, in the form of a rider to the regular naval appropriations bill; but it will come to naught at this session, for that part of the bill relating to work in government yards was promptly shelved when it reached the Senate committee.

A factor that is likely to exert considerable influence in favor of annually apportioning a certain number of war vessels to be built in government yards is the agitation for the eight-hour day on all government work. The eight-hour day has come to be the standard in all departments of the government and now the effort is being made to have all government work done on this basis, whether in private or government shops. The eight-hour bill that has been before Congress for some time has passed the House of Representatives, but at this writing its fate in the Senate is unknown. If it becomes a law there are likely to be some marked changes and many interesting developments in certain classes of steel and machine work. It is claimed, for example, that in the production of steel it is not possible, or at least advisable, to run with eight-hour shifts, owing to the difficulty of making the operation a continuous one through the entire period required for its completion, if more than one lot of men are engaged upon it. It is evident that there will be breakers ahead, also, when it comes to running a plant with part of the force working eight hours a day on government work and the rest ten hours a day on commercial work. In view of possible complications that are almost certain to arise in one way or another, should the eight-hour bill become a law, it seems very probable that Congress will eventually take part of the naval work, at least, from private yards and try the expediency of having it done under the complete control of the government.

* Through a typographical error the word "June" was printed last month instead of "May."

MAKE EARLY PLANS FOR THE ST. LOUIS FAIR.

The Department of Machinery of the World's Fair, 1904, is extremely anxious to learn at the earliest possible moment what the builders of power generating items (boilers, engines, fittings, etc.) of transmission items and of machinery for making machinery (machine tools, presses, shears, wood working machinery, etc.) desire in the way of exhibit space. A building covering an area about equal to that of the ground floor of the Grand Central Station in this city has been set apart for the machinery exhibits, but Mr. Moore feels that if the machinery industry properly realizes the opportunity offered and adequately avails itself of it, then even this huge building now being constructed will be inadequate. He urges machine builders who expect to exhibit to take the time now to determine how their products can be best displayed and what area will be requisite for their display. The filling in and filing a form will officially evidence this calculation, and there are no preliminary expenses connected with such action. It will be remembered that space and power to turn over the machinery are to be furnished free, and as the filing of a blank involves the sender in no expense, Mr. Moore asks the machine trade to co-operate with him to the extent of putting in his hands the ammunition whereby, if the building provided should prove too small, he can secure an additional allotment. Later on when the ground space shall have been set aside definitely his demand for additional buildings cannot be granted, however urgent the necessity may appear.

It is probable that in the eleven years intervening between the Chicago World's Fair in 1893 and the St. Louis World's Fair of 1904, the machinery industry has advanced and developed to a degree which cannot be approached by any other great line of industry, and Mr. Moore thinks the machinery builders can and should make this claim good. He is anxious to afford them the opportunity to do so, and he seems to have the power to do so, if he gets the assistance he asks for at the proper time. It must be borne in mind that he has a vast work on his hands, and that he has to plan for buildings and power and all kinds of facilities years in advance of their actual use; so when he asks for estimates from those directly interested it would seem that he puts it "up to" the machinery trade to help him now or not complain if it finds itself uncomfortably crowded or incompletely represented when the Exposition opens.

ELECTRO-CHEMICAL DEVELOPMENT—FIXATION OF NITROGEN.

The original Niagara Falls power plant, put in operation in 1895, was designed primarily for supplying power at Buffalo and other distant points, and it was expected that the power would be used mainly for mechanical purposes in driving factories, which otherwise would be equipped with steam plants.

The indications are, however, that the most important demands for the power are to be from the city of Niagara Falls itself, instead of from points at a distance, and that the larger part of the power will be employed for the production of

chemical products by electrolytic means instead of for mechanical operations requiring the use of electric motors. There are at least twenty electro-chemical industries now established at Niagara Falls, requiring upwards of 35,000 horse power, and most of their products were either unknown as commercial articles previous to 1895, or else were produced in a very small way, owing to the scarcity of electric power.

There are constantly new developments in the electro-chemical field that are of the utmost importance. The most recent of these, and what is characterized by Lord Kelvin as "the most remarkable thing I have seen during my visit to the United States," is a process for abstracting nitrogen from the atmosphere and combining it with various elements, producing the nitrates that are used so extensively in different industries. The fixation of nitrogen on a commercial scale has long been a subject for scientific research, and it now bids fair to be accomplished through a combination of mechanical and electrical means.

One of the most important uses for these manufactured nitrates will be for fertilizers for the great wheat fields of the Northwest. The annual production of wheat per acre rapidly decreases unless the nitrogen of the soil, so essential to plant life, is renewed from year to year. The chief sources of supply for this purpose are the nitrate beds of South America, where sodium nitrate is procured. Scientists tell us, however, that these nitrate beds will eventually be exhausted and it is absolutely necessary that there should be some other means for procuring this chemical.

The process of manufacturing nitrates by electrical means is controlled by the Atmospheric Product Co., of Niagara Falls, and is comparatively simple. It is based on the fact, long known to scientists, that when an electric spark is discharged, the air surrounding it undergoes a chemical change. In the present apparatus two cylinders are used, one inside the other, with an air space between. On the outside of the inner cylinder and the inside of the outer cylinder are electrodes between which there are electrical discharges produced by a high pressure current. The terminals are so near together that were the cylinders stationary the arcs discharged would be very short. One of the cylinders, therefore, is made to rotate rapidly, drawing out the arcs, as it were, to a length of eighteen inches, and these act on a current of very cold air flowing through the space between the two cylinders. The mechanical composition of the air is broken up, the nitrogen separating from the oxygen, and then the two combine chemically in the proper proportions and form nitrous oxide. The air is now conducted to an absorption tower where it is brought in contact with any substance of which a nitrate is desired. In contact with sodium it produces sodium nitrate; in contact with potash, it produces potassium nitrate, or saltpetre, used for gunpower.

Of the older Niagara industries the best known and perhaps the most important is that of the Pittsburg Reduction Co., for the production of aluminum. It is a significant fact that this company first operated at Pittsburg where coal could be bought for 75 cents a ton and yet, in spite of this low figure, it was found that conditions were more favorable at Niagara. About 10,000 horse power is now used in making aluminum, and it is reported that the Pittsburg Reduction Co. are also to establish a plant with an ultimate capacity of 50,000 horse power at Massena, N. Y., taking power from the new St. Lawrence Power Co. plant.

The works of the Carborundum Co. at Niagara Falls are an outgrowth of the aluminum industry. When using an electric furnace the crystallized silicon carbide known as carborundum was accidentally produced and from this has grown the extensive carborundum industry. Incidentally, also, it has been found that when a carborundum furnace is overheated some of the crystals are converted into graphite, and from this has been developed a process of making graphite, which is said to be of good quality. Other Niagara products are calcium carbide, from which acetylene is generated; another is caustic soda, and still another is metallic sodium.

The electro-chemical industries are still in their infancy, but the extent of their present development indicates the great possibilities that have come about within a few years, as a direct result of the great power plants at Niagara; plants that have been made possible only through the recent advances in mechanical and electrical engineering.

* * *

NOTES AND COMMENT.

If the metric system eventually becomes a universal system of weights and measures, as seems probable, it will perform one useful office which will do much to offset the many trials and tribulations incidental to its introduction and use in machine shops. It will straighten out the numerous gages now used for sheet iron and steel, wire, twist drills, machine screws, etc. It is reasonable to suppose that while it has been impossible to bring manufacturers to express these measurements in thousandths of an inch, they will gradually come to adopt the millimeter for the purpose if that should finally be the standard unit of length. Not alone in machine shops, moreover, will a single standard for various materials be appreciated. In almost every branch of manufacturing the inconsistencies are just as great. In the manufacture of woolen goods there are several systems for numbering yarns and the one intended must be specified. Some silk manufacturers use the Troy pound and divide it into 16 ounces instead of 12 ounces; while ordinarily we use the Avoirdupois pound and divide it into 16. In measuring water there are two or three standard gallons and several kinds of miner's inches. And so on to the end of the chapter.

INCREASING MACHINE WORK TO SAVE TIME.

Machining operations which a few years ago might have been regarded as too expensive and out of the question, are now quite commonly done even on work which must be sold at a small margin of profit. This comes about partially from the fact that modern machine tools are so efficient and have so great a capacity that, paradoxical as it may appear, it may actually be cheaper to perform certain "unnecessary" machining operations than not, because such operations facilitate subsequent operations, or erection. Again adequate machine tools revolutionize methods of manufacture in certain lines, especially in the case of lathe work turned from a bar instead of being made from separate castings. A case of more than ordinary interest illustrating the latter is that of the manufacture of a certain kind of car-wheel. This wheel is made of steel hot-pressed into shape between dies in a heavy hydraulic press. Formerly steel castings were made for each wheel, but now a steel ingot is cast long enough to make several car-wheels. The blanks are cut off in a heavy powerful lathe having a special compound cutting-off slide, which carries a number of tools on each side of the work. It has been found that this process is cheaper and more satisfactory in ultimate results than making separate castings.

PRODUCING ELECTRICITY "DIRECT."

A dispatch in the *New York Sun* tells of a "wonderful" invention by Prof. Figueras of the Canary Islands. If the dispatch is true, the invention *is* wonderful; but while it may be true, like the usual fish story it probably is not. It is stated that the invention is a "method of using the atmospheric electricity, without the use of chemicals, or dynamos and applying it without any motive force." The generator is said to collect the electric fluid, store it, and apply it to purposes where electric power is desired. It is further claimed that the inventor has constructed a rough apparatus and used it for lighting his house and driving a 20-horse motor, the current obtained being a 550-volt current.

However "fishy" this dispatch may appear to be, it is another evidence of the fact that many people are at work on the problem of producing the electric current by some simpler and more direct process than by the use of a motor and generator. It is reasonable to suppose that human efforts in this direction will some time be rewarded, either in the near or distant future. While no one may yet hold the key to the problem, no one will dispute that the solution may not be forthcoming at any time. What then of our immense power plants, the extensive works where steam engines, turbine waterwheels and dynamos are built, and the thousands of employees of such establishments? There is a

possibility of a change of conditions and shifting of industrial methods in the department of power generation that will surpass in magnitude any of the great industrial revolutions of the past.

USING THE WHOLE POWER OF NIAGARA.

Lord Kelvin (Sir William Thompson) is said to hold very radical views on some subjects. He is quoted as believing that the entire power of Niagara Falls should be appropriated for useful purposes, even at the sacrifice of their natural beauty and grandeur. "The saving and distribution of 4,000,000 horse-power for the benefit of humanity is more to be desired than the mere scenic phenomenon which delights the eye and impresses the mind." In accord with the same view Professor Crocker even ventures to predict that the world will eventually be reconciled to this idea—unæsthetic and utilitarian as it now appears.

We hope not and think not. What is all this industrial development for, anyway? Not to provide the necessities of life; people have these now. It is to enable people to enjoy more pleasures, more comforts, and to buy more things, now considered luxuries, but which will become necessities in future years. Improved machinery and manufacturing methods mean that each workman will produce more than he used to and can exchange his products for more things than he wants to have, and which his father and grandfather, who produced less, could not possibly have to enjoy. If the result of the development at Niagara is to give mankind more comforts and pleasures, what would be gained by destroying Niagara as a pleasure spot? Thousands enjoy the beauties of Niagara every year, and it would be robbing Peter to pay Paul if they were deprived of this pleasure in order that some thousands of others might purchase comforts and pleasures for their own use.

LARGE POWER PLANT FOR CHICAGO.

The Commonwealth Electric Co., Chicago, Ill., a branch of the Chicago Edison Co., is preparing to erect the largest electric generating plant in the country and probably the largest plant in the world. It will be capable of furnishing 100,000 horse power and will have cost $6,000,000 when completed. Five or six years will be required to erect the buildings and install the machinery. The location of the plant is on the south branch of the Chicago River, between Morgan St. and Center Ave., and between Throop and Quarry Sts. Compared with the great power plants now being erected in New York City, it will be much larger than any of them, except the Manhattan Elevated Railway station, which it will somewhat exceed. The latter is to contain eight 8,000 horse power units supplying a total of 64,000 horse power at normal load. The engines and generators, however, are designed to safely carry a 50 per cent. overload and thus have a possible capacity of 12,000 horse power each, or a total of 96,000 horse power. The new plant of the Commonwealth Company is to be built with the intention of supplying current for railroad operation, electric lighting or power purposes; but it is expected that by the time it is completed the demand for electric power for manufacturing operations will be so great that it will prove a profitable investment, even though no current is supplied for the street or elevated railways. The increase in the use of electricity for lighting and power in Chicago is estimated to amount to not less than 5,000 or 6,000 horse power annually and if the power could be more easily and cheaply procured the demand would undoubtedly be greater.

FIELD GUNS OPERATING "WITHOUT RECOIL."

It has been known for some time that the Ordnance Department, U. S. A., was experimenting with a new field gun, which is characterized as a gun "without recoil." This, of course, is an impossibility, strictly speaking, for action and reaction will always remain equal so long as the laws of nature continue to rule the world. At the moment of discharge the pressure against the breech of a gun must be as great as against the projectile.

There are several feasible plans, however, for lessening the effect of the recoil upon the gunner, and the feature of the new field piece is that this effect has been so far reduced that the guns can remain seated on the carriage while the gun is being fired. In the usual type of field gun the carriage recoils with the gun, but is designed to return automatically to as nearly its original position as possible. In the Krupp guns, the trailer of the carriage has a spring spade, which sticks into the ground and returns the carriage through its elasticity. In the Nordenfelt system the carriage wheels roll up on wheel shoes in the form of wedges, which also take hold of the ground. When the recoil is finished the carriage rolls back.

Wherever there is a movement of the carriage, however, there is always trouble from its failure to return to exactly the correct position. In the types of guns having a rigid carriage, with the recoil taken up between the gun and carriage, much greater rapidity of fire can be obtained. But as extreme rapidity of fire is rarely employed, the important point is that the gunner has plenty of time to point his piece accurately after each fire, without being hurried. Two of the most successful systems for absorbing the recoil are the Schneider-Canét and Ehrhardt. In these two systems the carriage and the wheels remain fixed at the discharge of the piece, while the gun recoils with certain parts of the carriage which are rigidly connected with it. This recoil, regulated by a hydraulic brake, is sufficiently prolonged for the force exerted upon the trail spade to be relatively insignificant, and the tendency to jumping is notably diminished. The gun is brought back into battery after firing by compressed air or springs. In both cases the carriage is so stable that the gunner can remain seated during the firing. Another device, the invention of Mr. Samuel N. McClean, utilizes the gases generated by the explosion to cushion the recoil and also to operate part of the breech mechanism. A gun on the McClean system is very much lighter than the ordinary type and is much steadier in action.

THE NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION.

Last month a number of the larger manufacturers of machine tools met in New York and formed an association under the above name "to promote the interests of the machine tool builders in the direction of good fellowship and liberal discussion pertaining to the manufacture and sale of machine tools." The association is in no sense a trust or combination, and its purposes are clearly stated in the above extract from the constitution. The meeting was originally intended to be an informal gathering of lathe manufacturers; but as it became evident that the interests of all the other machine tool manufacturers were common with theirs, the originators quickly decided to include the other branches of the machine tool trade.

There are twenty-eight charter members, and the following officers were elected: President, F. E. Reed, of the F. E. Reed Co., Worcester, Mass.; First Vice-President, Wm. Lodge, of the Lodge & Shipley Machine Tool Co., Cincinnati, O.; Second Vice-President, W. P. Davis, of the W. P. Davis Machine Co., Rochester, N. Y.; Secretary, P. E. Montanus, of the Springfield Machine Tool Co., Springfield, O.; and Treasurer, Enoch Earle, of P. Blaisdell & Co., Worcester, Mass.

At the meeting referred to, the subject of prices assumed a prominent place in the discussions, and in view of the heavy and continuous increase in the cost of labor and material, the principal lathe manufacturers agreed to advance their net prices 10 per cent., which appears to be generally considered a justifiable increase. The new prices go into effect July 1st.

* * *

Tests are now being conducted regularly with the Edison storage battery previous to placing the battery on the market for use in connection with automobiles. A light runabout was equipped with 21 cells weighing 332 pounds and had a single motor. In one test the vehicle was given a severe test, 12 per cent. grades being climbed, and after running 62 miles the battery still had capacity for several more miles. On another occasion the machine was run 85 miles over a smooth road on a single charge and upon its return the battery was in good condition and ready for recharge.

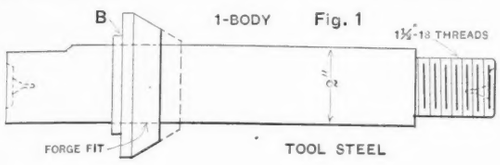
LETTERS UPON PRACTICAL SUBJECTS.

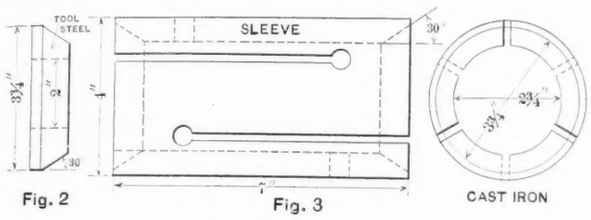
EXPANDING MANDREL; USEFUL DIAMOND TOOL.

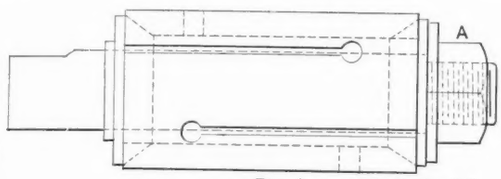
Editor MACHINERY:

The sketches herewith, Figs. 1 to 4, are of an expanding mandrel, which we have found most useful in our shop.

Little description will be necessary, as the sketches show the construction clearly. The body of the mandrel is shown in Fig. 1. This is of tool steel and is hardened and ground. A flange, shown in detail in Fig. 2, also of tool steel, is made a force fit against the shoulder *B*, Fig. 1, while the other flange







is a neat sliding fit. These must run absolutely true on the body. Fig. 3 shows the sleeve, which is of cast iron and which has six slots milled in it lengthwise and alternating from opposite sides, as shown.

Fig. 4 shows the parts assembled, and the mandrel complete. The nut *A*, when tightening, forces the flanges against the tapered faces of the sleeve, expanding the sleeve against the work and thus holding it securely. It will be readily seen that different sizes of sleeves can be used on the same body—in fact, if the flange is made as shown in the dotted lines, Fig. 1, sleeves from 2¼ inches to about 4½ inches in diameter can be used. This tool is an excellent one and will give satisfaction.

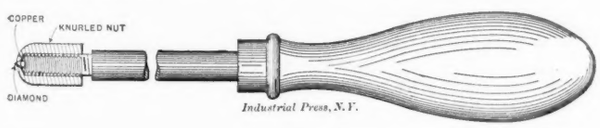


Fig. 5.

Fig. 5 shows a way of getting ahead of the diamond merchant. As a rule, a carbon emery wheel dresser never wears out, but it invariably drops out of the setting and gets lost. The one in our shop broke somehow, and one piece was lost, while the other we found too small to be reset in the ordinary way. Nevertheless, for the last two years we have been using that piece instead of the one that broke off and it is good yet. The sketch shows how this was accomplished.

The original rod was turned down at the end and threaded; a nut was made in the shape of a thimble, a small hole being drilled through the bottom and countersunk from the inside, forming a seat for the stone and allowing it to project slightly. Finally a piece of copper was placed between the diamond and the rod and the whole was screwed together. I advise all who are in any such predicament as we were to try this remedy. It works well.

L. MYERS.

Philadelphia, Pa.

MACHINERY STEEL DISKS.

Editor MACHINERY:

Some time ago we had to get out 3,000 machinery steel disks 1½ diameter by ⅜ inch thick, with a ⅝-inch hole drilled ¼ inch off center. The disks were to be made from ⅜ inch flat steel and turned to the exact diameter for a driving fit. At first I tried punching them out, allowing enough to finish in the lathe, but I found that this method left one side slightly rounding, which was not desired, so I made a jig for milling them out on a drill press, which proved very satisfactory.

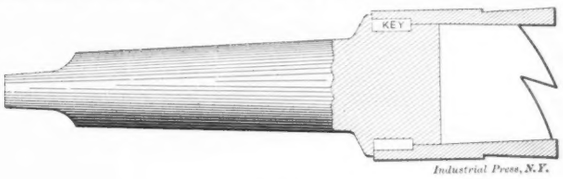


Fig. 1.

Two hollow-end mills were made, of the style shown in Fig. 1 with five teeth cut very deep to allow the chips to clear. The mills were reamed to size from the back, with a tapered reamer, and also slightly tapered on the outside, one inch back, to allow for clearance. One shank served for both mills.

The body of the jig was a square block of cast iron, *D*, Fig. 2, with a groove planed across the center 7-16 inch deep and just

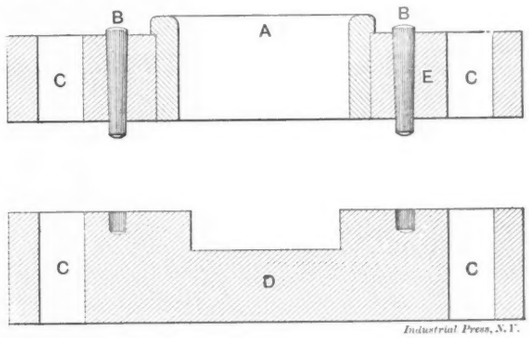


Fig. 2.

wide enough to take the steel bars easily. For convenience in milling we bought the steel in long bars, 1⅝ inches wide. A similar piece, *E*, of cast iron, served for a cap, a hole being bored in the center and fitted with a tool steel bushing, Fig. 2, which was bored to fit the straight portion of the mills, allowing for a running fit. The cap was secured to the body

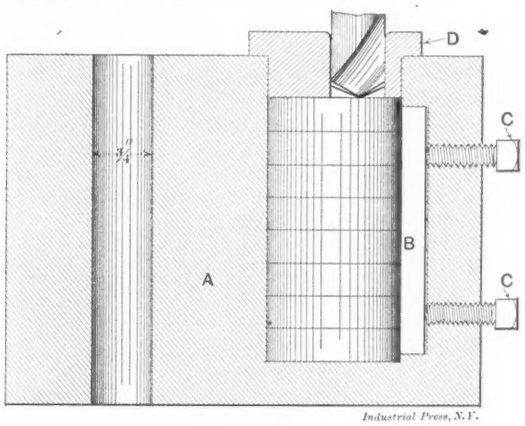


Fig. 3.

of the jig with dowel pins, *B B*, bringing the center of the bushing in line with the center of the groove. Two ¾-inch holes, *C C*, were drilled, one on each side, through both the cap and the body of the jig, by means of which it was secured to the table of the drill press with bolts. A setscrew through the cap held the bars firmly in place and a soap-water can with a spout and faucet completed the equipment of the jig.

The disks were milled 1-16 inch larger than the required size and eight at a time were drilled in a jig. This jig was simply a block of iron, *A*, Fig. 3, bored to a depth sufficient to hold that number of disks, and slotted for a key, *B*. When the disks were placed in the jig the key was pressed against them by means of setscrews *C C* and the holes were drilled, according to sketch, through a detachable cap, *D*, made of tool steel and hardened.

To make the arbor for turning the disks, a piece of machinery steel, *A*, Fig. 4, was bored out and screwed onto the spindle of the lathe and the end was faced off square and turned down to a little less than 1½ inch diameter. A hole, *B*, was then

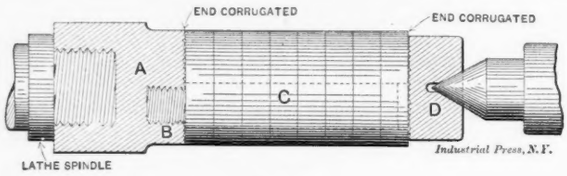


Fig. 4.

drilled in the end, ¼ inch off center, and tapped to ½ inch. The end was then corrugated in the shaper and case-hardened. A ⅝-inch arbor, *C*, with one end turned to ½ inch and threaded, was screwed into the hole in the face, projecting 2⅞ inches. Eight disks were placed on the arbor at one setting. A piece of tool steel, *D*, a little less than 1½ inches diameter by ¾-inch thick, corrugated on one side and centered on the reverse, was pressed firmly against the disks with the tail center.

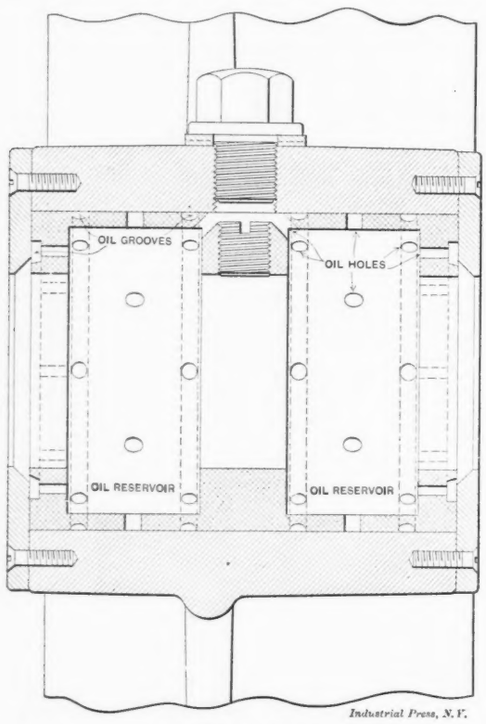
In this manner the 3,000 pieces were turned and never once slipped. The two end mills stood up all right and were apparently good for 3,000 more. The output was 600 a day and the cost of each disk was a little over ½ cent.

R. B. Casey.

ANOTHER LOOSE PULLEY BEARING.

Editor Machinery.

I have read with interest the articles on loose pulley bearings, and send you a description of one used in our shop. We were having trouble with the high-speed loose pulleys, and



Loose Pulley Bearing.

after trying several combinations, with poor results, we adopted a bearing designed by our overhead works man, which filled the bill to a T.

A section through pulley and bushing is shown by the sketch. The bushing is of bronze, with two oil reservoirs inside, and small holes drilled through the bushing into the reservoir to conduct the oil to the pulley bearing by centrifugal force. Oil grooves are cut on the outside of the bushing connecting these small holes. A groove in each end is connected to the oil reservoir by a series of small holes. The object of this is to provide a way for the oil to flow from the ends of the bushing back to the reservoir when the pulley stops, and to prevent the oil from flowing out onto the shaft. The bushing is fastened to the shaft by a setscrew, as shown.

The pulley is bored out to a running fit for the bushing and provided with a steel plate, fastened to each end. The end of the hub of the pulley and the end of the bushing are covered with a coat of shellac and the plate is then screwed to place. This makes a tight joint, so that the oil cannot leak out. The plate has a center hole that clears the shaft about 1-64 inch on a side, and the hole is chamfered next to the bushing so as to make a groove that draws the oil from the shaft into the groove in the end of the bushing. From thence it flows through the small holes into the oil reservoir.

There is a screw in the hub of the loose pulley in line with the setscrew in the bushing, and a little larger, so that the screw in the bushing can be taken out or unscrewed to remove the loose pulley and bushing from the shaft. The screw in the pulley hub is removed when it is desired to put oil into the bushing reservoir. There are two oil holes at the sides of the setscrew in the bushing, through which the oil flows. A leather washer, under the head of the screw, prevents the oil from leaking out. No felt or wood is used in the bushing.

I think this combination will go a little ahead of those recently described.

Edwin C. Thurston.

Providence, R. I.

MILLING SQUARE BLOCKS SQUARE.

Editor Machinery:

Several years ago I had charge of the milling department in a shop doing a great variety of work, and as work can, as a rule, be made to shape, cheaper and better by milling than by any other process—when done in large quantities—it usually devolved upon me to see that such work was done, done as it should, and, last but not least, done cheaply. At one time I was given several hundred blocks of square tool steel to finish, ⅞ inch x 1 inch 1⅛ inches, and the total cost of labor was not to exceed three cents per block.

I found in the tool closet a pair of milling machine vise jaws, each having a narrow projection on the face for the work to rest on, as indicated in Fig. 1. These jaws were used to hold the work for the first operation, the blocks being held by the ends between the jaws. A pair of straddle

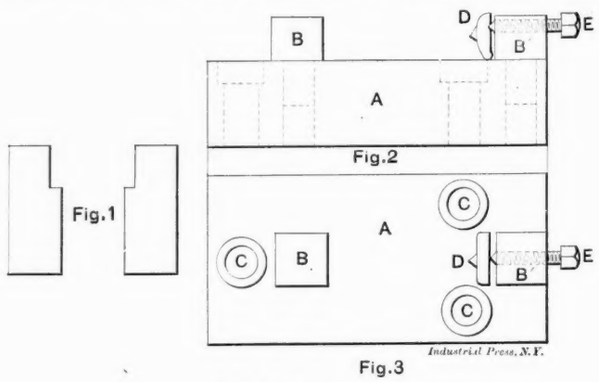


Fig.3

Details of Milling Jig.

mills was rigged to cut the proper thickness—⅞ inch—and this dimension was milled first in order to have the broadest side lying down during the second cut. To hold the pieces for the second and third cuts a jig was made as follows: A slab of cast iron, *A*, Figs. 2 and 3, was drilled for the studs *B B'*. The holes were ¾ inch in diameter and 3 inches apart. The studs were made of 1-inch square stock turned at the lower end to fit the holes in the slab and projected about ¾ inch above it. A ½-inch hole was drilled and tapped in *B'* for the pointed set-screw *E*, which, acting on the tilting block *D*, caused the latter not only to force the work against the stud *B*, but also forced it downward against the slab *A*

at the same time. The point of the setscrew impinged against the back of the tilting block above the point on the block, otherwise it would not have tended to draw the work down. The tilting block was ⅛ inch narrower than the finish dimension of the blocks. By the use of this fixture it was possible to get the sides milled by the second operation perfectly square with those milled at the first, as the slab could be shimmed under one edge until it was exactly right. The same fixture was used to mill the ends of the pieces.

The blocks milled in this manner were inspected and pronounced all right. The boy who did the milling ran six machines, doing the work by the piece. He received twenty cents per one hundred cuts. Since there were three cuts on each block, the cost of milling was six-tenths of a cent each.

I have used the same method, but with more permanent fixtures for doing similar work in batches of thousands and have always found it all right when perfect cleanliness was observed, and this condition must always exist when accurate work is expected, no matter what method is employed.

To do any straddle milling properly the spindle and table ways must be exactly at right angles. I have generally found it necessary to correct the alignment of almost every milling machine I have had to use in doing work of this description. Otherwise the heel of the milling cutter on one side will drag on the work, making it inaccurate. Milling cutters for this work should be ground slightly concave on the sides for clearance, the corners should be slightly rounded, the teeth should be coarse and stubbed, and should be extremely hard.

By following the above instructions with such variations as the individual job may call for, it is possible to do very satisfactory milling on a class of work that usually gives much trouble.

E. R. MARKHAM.

Worcester, Mass.

A DEVICE FOR TESTING GAGES.

Editor MACHINERY:

In some shops certain thin bow back gages are used which will get out of true if accidentally dropped, or if a light rap is given the machine. When this happens the inspector will take a 2-foot rule, try the gage, and finally send it to the tool room for repair. Here the tool man tries it on a steel rule, gets the mate to it and adjusts them by pening. I send a drawing of a micrometer caliper which I designed several years ago for the purpose of testing gages such as these.

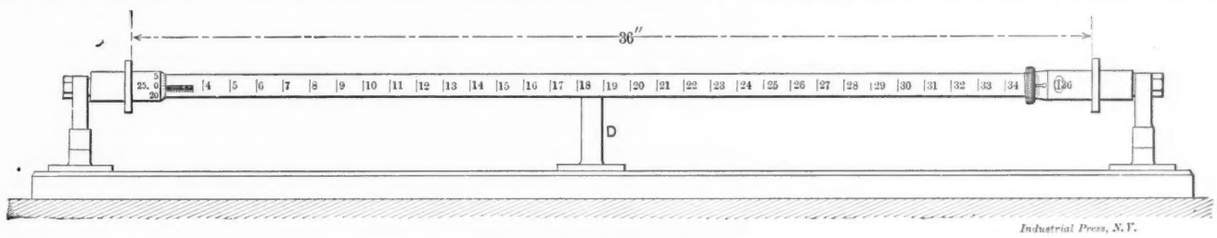
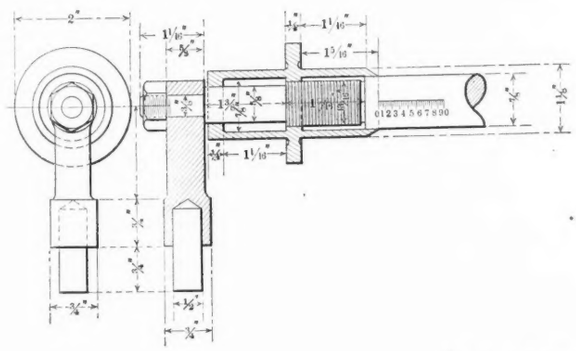


Fig. 1. Gage Testing Machine.



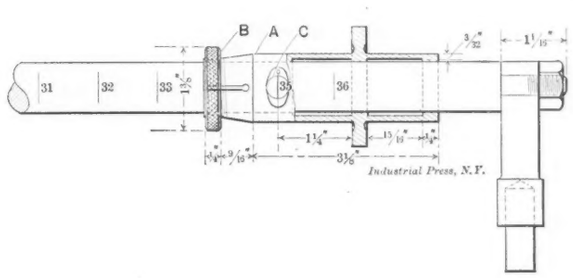


Fig. 2. Details of Measuring Heads.

The caliper will test both inside and outside gages. Piece *A*, Fig. 2, can be adjusted to any inch on the bar by loosening thumb nut *B*, and the desired inch can then be located through the opening *C*. The adjustment for thousandths can be taken from the micrometer adjustment at the other end. *D*, Fig. 1, is a support for the bar, and can be moved along the bar when necessary. This caliper can be used to set inside and outside calipers.

C. W. P.

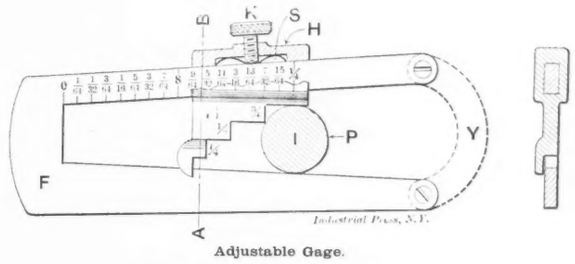
Holyoke, Mass.

HANDY CALIPER GAGE.

Editor MACHINERY:

The sketch shows a caliper gage which I have found to be a handy tool and very easy to operate.

It consists of a V-shaped frame, *F*, on which runs the sliding head *H*. The jaws of the V-slide taper ¼ inch in 3 inches, thus permitting very coarse graduations, so that 1-64-inch graduations are 3-16 apart. The sliding head has several steps, each of which is stamped with the size which it measures. This head may be set in any position by the knurled clamp screw *K*, but in ordinary use it is left free to slide on the bar, the spring *S* affording sufficient friction to prevent looseness.



Adjustable Gage.

The range of the gage is from 0 to 1 inch, and markings for various wire gages or any desired graduations may be placed on the other edges of the frame so as to measure to any system desired.

To measure the diameter of anything, with this gage, it is put over the piece until one of the steps on the sliding head bears against the piece being measured. The gage is then pushed onto the piece until it fits about as snugly as a micrometer or vernier caliper, when the reading is obtained by adding the amount stamped on the step against which the piece bears to the amount registered on the frame at the left hand side of the head. Thus, in the sketch, the piece being measured, *P*, is ¾ + 9-64 inches or 57-64 inches in diameter. When it is practicable to apply the gage over the end of the piece to be measured, the yoke is placed in the end, as shown by the dotted lines. This gives greater stiffness and prevents the sides from spreading.

M. H. BALL.

Watervliet, N. Y.

VARIOUS KINDS OF PARALLEL PROJECTION—DRAWING BOARD APPLIANCE.

Editor MACHINERY:

There seems to be considerable ignorance on the subject of the different kinds of parallel projection and perspective, inasmuch as "Cavalier" and isometric projection on the one hand, and monodimetric and isometric on the other, are quite frequently confused. Furthermore the angles, dimensions and proportions on many Cavalier and monodimetric sketches are wrongly given. This being the case, I beg to offer a few illustrations of the various projections above mentioned, choosing as the subject a cube.

The three geometric projections which are necessary to enable one to get all the dimensions of any subject—plan, front elevation and side elevation—are, in the case of the cube, all alike: Three squares, each of the same size; and all unforeshortened in any direction. It is unnecessary to give

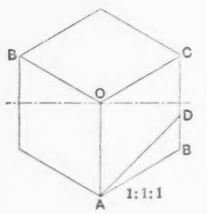


Fig. 1.

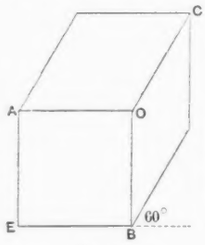


Fig. 2.

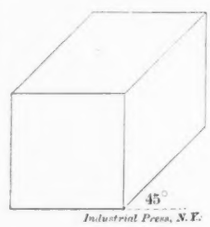


Fig. 3.

these here. The isometric projection of the cube has a hexagonal outline, as shown in Fig. 1, and gives in one drawing three sides forming one of the corners of the cube. In it all lines representing sides of cube faces are equal; and as compared with those representing the same cube on the same scale, in plan and elevation, one foreshortened equals about 9-11—more exactly 89-109, and still more exactly 0.8165. In Fig. 1 the line *A D* represents the length of the side of the cube in plan or in elevation. The three meeting cube edges or cube axes form angles of 120 degrees with one another. All measurements made in these three directions are on the same scale: 0.8165, that of the same lines in the plan or in the elevations.

This "isometric" or "equal measurement" is that one of the three classes of "axonometric" projections where all three of the axes of the cube are equal. The angles made by the non-vertical axes with the horizontal are 30 degrees. All lines parallel to the long diagonals of the rhombuses are parallel to the projection plane and can be measured on the same scale with one another and with diagonals of the geometric projection.

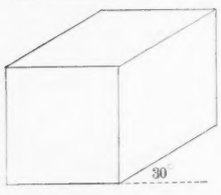


Fig. 4.

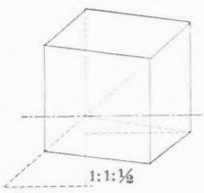


Fig. 5.

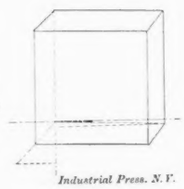


Fig. 6.

In a second axonometric class two of the axes are on the same and the third on a different scale. The relation may be 1 : 1 : ½, or 1 : ½ : 1, or 1 : 1 : ¼, or any one which suits the draftsman. All measurements are foreshortened—naturally those of one of the axes twice as much as those of the other two. One of the axes being assumed to be vertical, the other two form different angles therewith and with the horizontal.

In Fig. 5 the relation is 1 : 1 : ½; and in this case the two long sides of the same cube shown in Fig. 1 are foreshortened to 0.9428 and the short side to 0.4714, their length on the plan. The angles of the two non-vertical axes with the horizontal are 70 degrees 11 minutes and 41 degrees 24½ minutes; the natural sines of these angles 0.1250 and 0.6614 respectively.

In Fig. 6 the axial relation is 1 : 1 : ¼; the foreshortening of the two long sides is 0.9847 and that of the short one 0.4923; while the non-vertical sides stand with the horizontal at angles of 1 degree 47 minutes and 44 degrees 6½ minutes; the natural sines of which are 0.3112 and 0.6960 respectively. All of the above mentioned projections are true ones, such as would be cast by the rays of the sun striking at right angles to the projection plane, which in the case of the isometric projection is at 45 degrees to the horizontal plane and at right angles to the diagonal of the cube.

The so-called "Cavalier" projection, Fig. 3, is a mongrel. It is an "oblique parallel" projection composed of one face in geometric plan (or elevation) and of two other faces which are not in true axial projection; and in the case of the cube one face is a square and the other two 45-degree rhombuses. Whether the sides of the square and of the rhombuses are foreshortened or not makes no difference—all are on the same scale, and all measurements made in the three directions, *O A*, *O B* and *O C*, are also on the same scale.

There are two other principal oblique parallel systems which are known as "Cavalier" projections and which are shown in Figs. 2 and 4. Fig. 2 is Sopwith's 60 degree, and Fig. 4 his 30-degree system. These are also mongrels, and all measurements in the three directions, *O A*, *O B* and *O C* are on the same scale one with the other. Whether called "foreshortened" or not makes no difference.

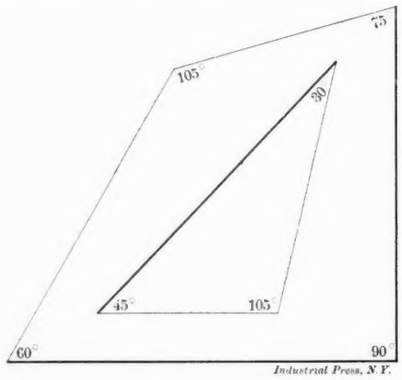


Fig. 7.

Fig. 7 is a sketch of a convenient appliance for the drawing board, for any one who has to do much drawing, either in isometric or in Cavalier projection. It consists of a 60-degree triangle which has been truncated at an angle of 75 degrees with the vertical side, leaving the angle at the former hypothenuse 105 degrees. Inside, it is cut out to 30, 45 and 105 degrees.

ROBERT GRIMSHAW.

Hanover, Germany.

[In isometric projection, which is the most used of any of the systems described above, the edges would be foreshortened, as stated, if it be assumed that the cube or other object is represented in the size it would appear to an observer. As a matter of convenience, however, the vertical and 30-degree lines in isometric projection are usually drawn full length, equal to the length of the edges of the object which they represent. While this makes the sketch appear a little larger than the object, any of the lines of the projection which are either vertical or at an angle of 30 degrees with the horizontal can be scaled as readily as the lines of a working drawing. In this fact lies the chief advantage of isometric projection. While a drawing in isometric projection appears distorted, it still gives a picture effect, readily grasped by the eye, and at the same time the lines which are parallel to the elements of a cube can be measured.—EDITOR.]

A DEVICE FOR WINDING SMALL SPRINGS.

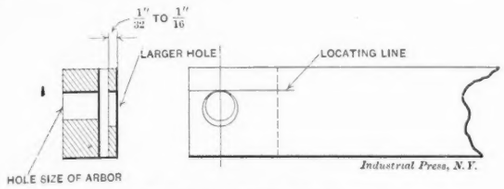
Editor MACHINERY:

In the shop one often sees a machinist trying to wind a spring on a small arbor, and when about one-half the length has been wound the arbor bends, the process of straightening begins and the spring, when finished, presents a very unsatisfactory appearance. The following method obviates all of this trouble and is extremely easy to apply.

Take a piece of tool stock (the stub end of any old lathe tool will answer the purpose) and in the end cut a slot of sufficient width to allow the spring wire to run freely through it. This slot should be as near one side of the tool as seems prac-

tical; 1-16 inch is generally sufficient, although for close wound springs it cannot be over 1-32-inch. On both sides of the tool mark a line at the same distance from the top of the tool. This locates the tops of the holes which are to be drilled in the sides.

On the thicker side of the slot, which will be the tailstock side when the tool is in use, drill a hole the size of the arbor on which the spring is to be wound. This hole runs into the slot. On the other side drill a hole, the top of which will be on the same line as the top of the first hole, but whose diameter is the diameter of the arbor plus twice the diameter of the wire of which the spring is to be made. This allows ample clearance for the spring to pass out of the slot where it is wound. The construction of the tool will be clearly seen by the sketch; it is used in the tool post as an ordinary lathe tool.



Fixture for Winding Springs.

To wind a spring, gear the lathe for the same number of threads that you wish the spring to have turns per inch. In the chuck place a piece of wire of the diameter you wish to use for an arbor and run it through the hole in the tool.

Now run the spring wire down through the slot and out through the hole on the headstock side and grip the end in the chuck. Place the carriage where you wish to start winding the spring and throw in the thread nut. Keep a slight tension on the wire and the spring will wind surprisingly easily. Springs ⅛ inch outside diameter can be wound by this method without any difficulty. J. A. P.

HARDENING COIL SPRINGS.

Editor MACHINERY:

An experience I had several years ago, with regard to the hardening of coil springs, has been brought to mind by a person who recently asked my advice on this subject. He was trying to harden some heavy coil springs that were used to sustain a heavy load under varying conditions. He had been hardening this same spring for years, using a bath of sperm oil with excellent results. But the company in whose employ he was decided that they were paying too much for their steel. They found a brand they could get two cents a pound cheaper, so bought several tons of it, and "sprung" it on him. Well, to make a long story short, he could not harden it in the sperm oil, and so came to see me. I told him to use a mixture of 50 parts sperm, 49 parts neat's foot oil, and 1 part resin.—This is an old standby with some spring hardeners. He tried it but found that the springs would set. He then tried cold water, but the springs broke and in despair he came to see me a second time. I happened to remember my former experience which I related to him.

I was given some heavy springs to harden. I tried oil but the springs came out of the bath as soft as they were before they went into the fire. I tried cold water and found that the springs broke, even when drawn very low. Finally an old, white-haired man, in whose experience and judgment I had unlimited confidence, came to my rescue. He whispered in my ear: "Try bilin' water." I went to the boiler room, got a tub of boiling hot water and took it to the fire where I had a spring ready to dip. I plunged it in the tub and worked it around well; then I took it out, put some tallow on it and flashed it over the fire for temper. From that hour my reputation was made, so far as that shop was concerned.

I advised my client to heat a tank of water to the boiling point and try it. He did so and reported that it was a huge success.

In these days of money-saving—money-wasting many times—schemes, it is necessary to be "all things to all kinds of steel," if you are in the hardening business; and for those who may get steel that will not harden satisfactorily by the method I described in the May number, I make haste to send this "kink."

It is one of my duties in connection with the institution I am connected with, to give lectures occasionally to the members of the evening classes. These lectures are open to the public, and are very well attended by mechanics, blacksmiths and others interested.

One of the talks was an explanation of a special process of hardening steel. From the appearance of the audience I judged they were very much interested in what was said. At the conclusion one chap came to me and said: "Do you think you said anything new? I have known all that for 25 years." But a canvass of the audience showed that there were more than a hundred present who never had heard of the process. So I felt well paid for having given the talk, even though one man "knew it all." Carrying out the same line of reasoning, although these articles, which appear from time to time, may not be new to everyone, they possibly may be of use to someone.

There is no one operation which is a source of so much trouble in shop work as hardening—satisfactory hardening—of steel; there are so many different makes of steel, no two of which act exactly alike when treated with fire and water, that it is well and very necessary to keep posted on the nature and peculiarities of the different makes, as far as possible. E. R. MARKHAM.

Worcester, Mass.

INSTANTANEOUS SIGNALS FROM STEAM WHISTLES.

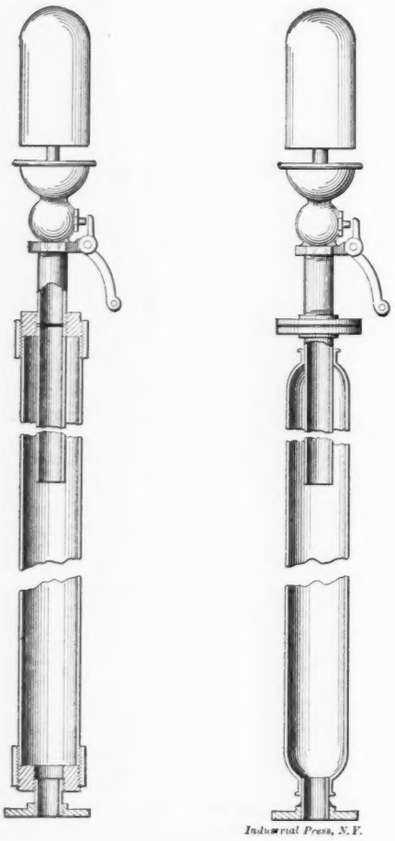
Editor MACHINERY:

From noting the time that elapses between the admission of steam to whistles and when the sound becomes audible to the observer, the distance from the point of observation taken into consideration, it is evident that a great many steam whistles on power plants, factories, and steam vessels are improperly connected. In many cases steam whistles are employed for giving alarms for fire and signals of danger. In this case they should be so installed that a clear note will be given in the shortest possible time, as seconds count in emergencies. The principal cause of this delay in giving forth a clear note of warning is from the improper insulation of the connecting pipes, or from pockets in the pipes that catch the water of condensation which is blown out through the bell of the whistle and deadens the vibrations.

Recently the writer's attention was very forcibly called to this evil. With several friends he was standing on the upper deck of a steam vessel waving adieus to friends on the pier; a signal was given by a blast from the whistle for "All aboard." Well, from the inopportune bath we received from that whistle we naturally thought that signal was intended for "All overboard." As folks generally bathe themselves previous to taking a pleasure trip we thought this additional bath quite unnecessary and said some things not written in Sunday-school books. Being of an inquiring disposition and having installed several whistle pipes, I became interested to such an extent as to investigate the lead of that particular whistle pipe to locate the defects, if possible, for my own information. Upon examination I found what I had previously termed an ideal whistle pipe for the proper return of the water of condensation back to the boiler. This pipe led off from the top of the steam drum with an easy flowing goose neck bend merging into a straight section running parallel to the smoke pipe. From the excessive spraying we received from this whistle I was placed in a quandary in regard to future installation of these pipes. Afterward, from experiments made, I found that when steam was flowing through pipes, the dry steam in the center of the pipe flowed much faster and had considerably more elasticity, which forced the heavy vapor and water of condensation to the wall or inner surface of the pipe. From these conditions I conceived the idea of expanding the pipe at or near the whistle to twice the area of the line, and inserting an internal tube through the top, as shown in the engravings, Figs. 1 and 2. In the movement of steam through this arrangement, as it enters the chamber from the greater sectional area it is allowed to expand and the dry core of steam forces

the heavy vapor to the extended area and rushes upward through the internal pipe to the whistle and instantly sounds a clear note upon the bell. The advantage of the internal tube at the top of the separating chamber is to prevent the water from escaping through the whistle should a very long blast be given. At the completion of the signal whatever heavy vapor or water there is in the chamber returns to the boiler or to pipes from which connections are made.

To more fully test the efficiency of this device as a separator, and to meet the requirements of defective arrangements of connections, a pocket was made in the steam pipe and partly filled with water. The whistle was given a long blast to see the effects of the water in the pipe. Under this unfavorable condition a clear, bell-like sound was given and not a particle of spraying could be perceived or felt. Upon the completion of this trial the drain in the pocket was opened to remove the water; it was found to be dry. This water, it seems, was driven into the chamber with such a force as to divide it into minute particles and it was evaporated or passed off through the whistle without affecting the sound. From the efficiency of this chamber in separating the dry and heavy vapors it is not necessary to clothe it, as the experiments were made in very cold weather with exposed pipes.



Industrial Press, N.Y.

Fig. 1. Piping for Whistles. Fig. 2.

To give this arrangement a more neat appearance, the pipes at each end can be insulated to the diameter of the chamber to make it uniform throughout. Fig. 1 shows the method of construction for a screw pipe. On each end of the chamber there is a straight coupling with a reducing plug. The top plug is threaded from both sides so that the internal tube may be screwed in before entering the plug in the chamber. Fig. 2 presents the method of construction for copper pipe. The ends of the chamber are swaged down to the outside diameter of the connecting pipes. The internal tube projects through the top of the chamber sufficiently for securing a flange to receive the whistle. The bottom nipple is entered flush with the inside of the chamber so that no impediment will be offered to the return of water should there be any in the separator. These joints are brazed in the usual manner, and when finished the chamber is very neat in appearance. Where steam sirens and whistles are employed to give alarms for fires and to call men to stations, with a separating device installed in the steam line as herein described, the signals will be instantaneous.

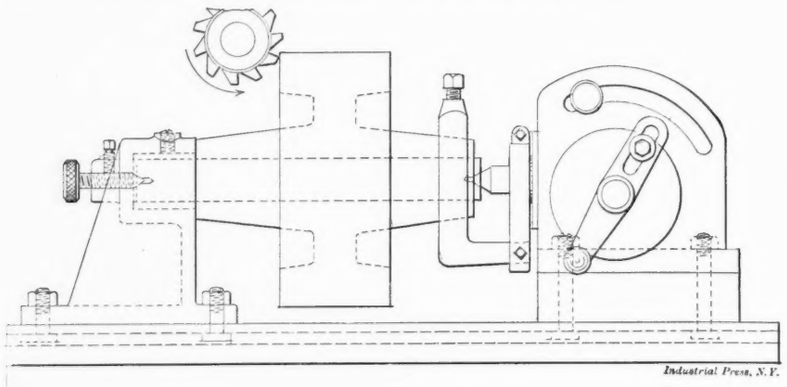
GEO. C. STANLEY.

Portsmouth, Va.

GEAR CUTTING ON A UNIVERSAL MILLING MACHINE.

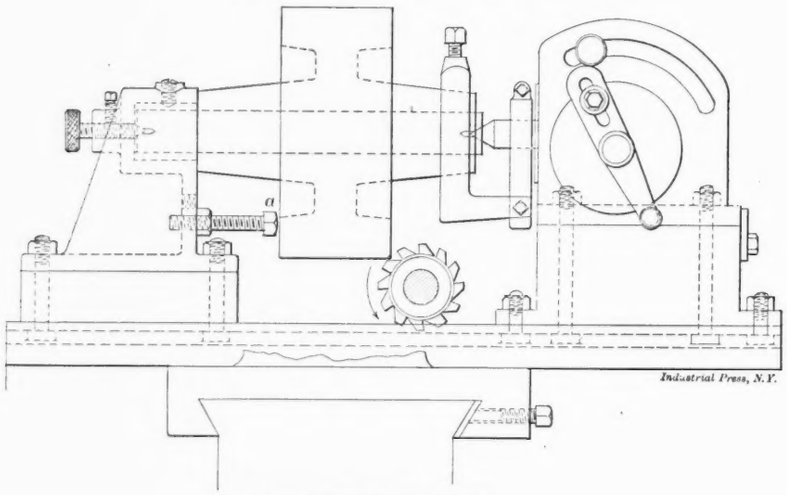
Editor MACHINERY:

We were in need of a gear cutter and a milling machine for general work. We had quite a number of 3 and 4-pitch cast steel gears and pinions of various faces, but the amount was not sufficient to warrant the purchase of a regular gear cutter. So I decided that a universal milling machine, which could be adapted to all such work as is met with in most shops and suitable for a good grade of tool work, could also be used for cutting the gears. I therefore obtained such a machine and fitted it up as shown in Fig. 1.



Industrial Press, N.Y.

Fig. 1. First Method of Cutting the Gear.



Industrial Press, N.Y.

Fig. 2. Method Finally Adopted.

The dividing head was shimmed up with an elevating block 3½ inches high, while the tail end of the arbor was carried in a special tailstock, which was described in the February number of MACHINERY. With this arrangement the best time that I could make in cutting a 4½-inch face gear, using an abundant supply of oil, was 25 minutes for the roughing and 5 minutes for the finishing cut for each tooth. The reason that better time could not be made was that the cutter did its work about 10 inches from the top of the table and, consequently, was "picking up" the work. This was a very bad feature, the leverage being so great that the end of the table vibrated over an eighth of an inch with the lightest feed.

As we had taken the machine on 30 days' trial, it began to look as though it would not stand the test "worth a cent," although in every other respect it seemed to be all right, yet we certainly could not afford to cut gears in this manner. Finally, however, I hit upon a scheme which proved satisfactory and paid for itself in a short time.

The principle is to do the cutting as close to the table as possible, and to cut down to the machine instead of lifting the work. The method by which we accomplished this is shown in Fig. 2. The elevating block, shown under the headstock in Fig. 1, was placed under the tailstock and a new and thicker block was made for the tailstock. This brought the centers sufficiently high to allow the cutter to be run under the gear instead of above it, and the left-handed rotation of the cutter had a tendency to pull the work down to the table, where formerly it lifted it away.

In cutting the smaller blanks the cutter ran in a pan of oil which was placed beneath it on the table. With the larger sizes, as there was no room for an oil pan, the oil was supplied to the cutter by a rubber tube leading from a tank. The cutter used on the largest sizes ran in the middle of one of the T-slots, as shown in the figure. The pressure toward the tailstock was resisted by two jack screws, *a*, in Fig. 2, which bore on the gear on each side of the space between two of the

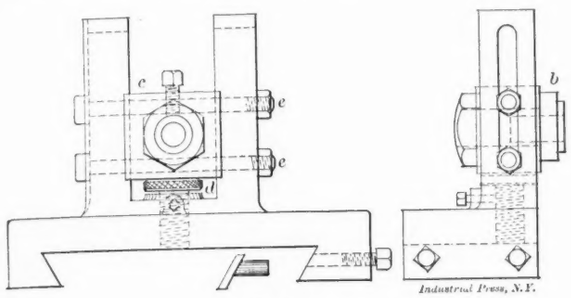


Fig. 3.

teeth, and in a line directly below the rest of the teeth. These screws were ordinary ¾-inch setscrews with the heads ground conical. They were provided with check nuts to lock them firmly in position where set.

A strip of ¼-inch plate was bolted to the back of the headstock block, projecting upward, and thus preventing the headstock from being pushed backward when these screws were being adjusted.

The outer end of the arbor is supported by a bushing, *b*, Fig. 3, carried in an adjustable housing. Between the parallel sides of the housing slides is a block *c*, which is supported by the jackscrew *d*, and firmly clamped by the bolts *e e*. The slot in which this block slides is of sufficient length, so that when the largest gears are being cut the block rests on the screw at the bottom of the slot, and when the smallest sizes are cut the top of the block is flush with the top of the housing.

The gib used in this housing is of unusually convenient design, as its peculiar construction prevents it from falling out when the housing is removed from the table.

The sliding block is fitted to receive the same bushing that was furnished with the overhanging arm belonging to the machine. When the cutter is being set this block is unclamped and free to slide up and down. The cutter is set so as to just touch on the bottom of the blank, the table is then moved so as to bring the cutter at one side of the blank and then lowered an amount equal to the depth of the cut to be taken. The sliding block is first clamped by means of the two bolts *e e*, and the jackscrew *d* is then brought up to support it.

The cutter is placed central with the arbor by setting to a line cut with acid and wax in the usual manner on top of the tailstock. This is far more satisfactory than locating the cutter by the center point, as these points are liable to be blunt or broken, thus making it difficult to set a cutter accurately by them; whereas by using the line it is very easy to get the center line of the cutter tooth to exactly coincide with the mark on top of the tailstock.

As before stated, our first method required 25 minutes for roughing and 5 minutes for finishing each tooth. With the new method I was able to cut a tooth of the same pitch and face in 8 minutes, and but one cut was necessary.

To get the feed belt to do its work we simply slipped one belt over the other, and these did the heavy duty required.

To watch this machine is a real pleasure; it seems to "walk through the work" without the slightest vibration being noticeable, which is remarkable, for it is a comparatively light machine, never intended for the purpose to which we have put it.

The labor cost of cutting these gears is reduced very considerably, and what is more important, we have a machine suitable for our various grades of work, including tool making. Besides this we have saved the price of an expensive gear cutter which, half the time, would stand idle.

An oil pump, some lard oil for a lubricant, and a drip pan for chips and oil completed our outfit, which was a money saver from the word "go."

ROBERT LACHMANN.

Chicago, Ill.

THEORY AND PRACTICE.

Editor MACHINERY:

The reader is hereby introduced, without further ceremony, to Messrs. X. and Y., both responsible employes in a small goods factory of established reputation. X. has charge of the drawing room, and hence is responsible for the products therefrom. He is a young man, technically educated, a good talker, possessed of some natural ability and especially able to convincingly appropriate, as original, good stray ideas. His shop experience has been limited to the looking on, rather than the actual practice. Y. looks after the experimenting; that is, he builds working models of such devices as are approved by the management, improving them, if possible, from his accumulated mechanical knowledge, skill and inventive ability. A table of natural sines, or logarithms, would not be of use to him and he might not be able to state a single geometrical proposition in the words given in books; but tell him a result to be accomplished and he will contrive some means for doing it and doing it practically, if it is reasonably possible.

Should the above individuals seem like old acquaintances, the facts must be blamed for their reintroduction not the writer, because it so happens that these are living people and the case an actual occurrence. This is stated because the reader may think this to be a suppositious re-statement of the old and ever-recurring troubles between the engineering force and construction departments, between draftsman and mechanic, and, in a manner, between theory and practice.

Naturally these two departments are in close touch with each other, and in view of the related circumstances, it may not be surprising to further state, that in many cases—in fact the majority—the drawings are made *after* the experimenting has been done, and the mechanism demonstrated and developed, which is a reversal of the usual and logical plan. The case in point, however, came to Y. in the shape of a set of blueprints, bearing X.'s authorization. The mechanism shown (neglecting non-interesting details) was operated by a coiled spring. Occasionally it became necessary to release the controlling pawls, at which times a certain movable part would be carried forward by the action of the unrestrained spring, until it brought up against the frame, which it would do with such violence as to endanger the whole construction. To overcome this a brake was shown applied to the drum by a hand lever, so arranged as to exert a certain definite pressure only, expected to be enough in amount to retard, but not wholly stop the drum from revolving. To understand the case clearly it may be noted that the spring drum case was a short cylinder of metal, say four inches in diameter, with a flat surface on one end, against which a leather-covered disk one inch in diameter was brought into contact by the hand lever.

After carefully looking over the plans Y. suggested that the diameter of the disk be enlarged. This, he said, could be done with a slight change, and the exertion of force applied to the lever would then be *less* to produce an equal amount of friction on the drum, accomplishing the same results in checking the speed of its rotation, and moreover the disk would last longer by reason of the wear being distributed over more surface. All this X. flatly denied, saying: "Friction is independent of area or velocity and is proportional to the applied perpendicular force. Then Y., to prove himself correct, showed X. a small shaft which, when placed between centers (one of which revolved) would invariably turn with the live

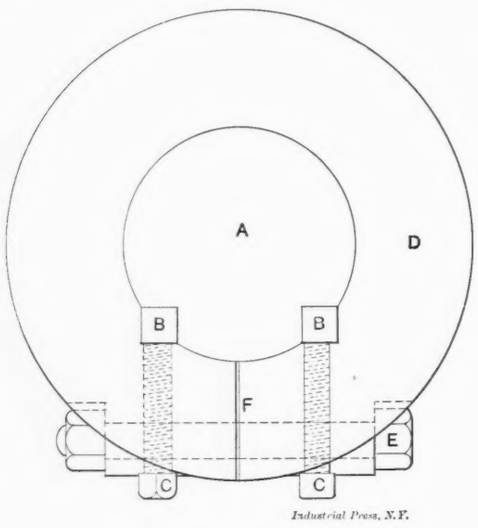
center or remain stationary on being turned end for end. The only perceptible difference was that the center hole at one end was reamed deeper than at the other and, of course, the deep end, having more surface in contact, either drove the shaft or caused it to remain still when on the dead or stationary center. X. did not explain the apparent paradox to his reasoning but contented himself with citing several technical works treating on the subject and suddenly had important business elsewhere.

No doubt both X. and Y.—and likewise others—would appreciate a clear explanation of the principles of frictional resistance, as applied to the ordinary shop problems that are constantly arising, and about which much contradictory theory and uncertain practice prevail. W.

DIAGONAL KEYS FOR ENGINE SHAFTS.

Editor MACHINERY:

The article in the June issue on page 305 seems to convey the impression that the Kennedy system of shaft keying is something not generally known in mechanical circles outside of that having to do with rolling mill and engine building. While this condition may be quite generally true, it is by no means the whole truth, as there is at least one engine building firm that is using substantially the same principle, with additional features. The system used by Ball & Wood, the builders of high-speed automatic cut-off engines, employs diagonally-set keys and in addition a split hub, clamping bolts and setscrews bearing on the keys. The whole makes a combination for securing a flywheel hard to beat for permanency, yet it is one that can be readily loosened so the flywheel may be removed from the shaft whenever required.



Method of Keying Flywheel.

The accompanying cut shows the construction so clearly that an extended description will be unnecessary. Two square keyways are milled in the shaft 90 degrees apart, and so their diagonals are radial. The keys *B B* are about 1⅛ inches square for a 6½ inch shaft. The hub *D* of the flywheel is split as shown at *F*. Two or more clamping bolts are provided to draw the split hub together on the shaft, one of which bolts is seen at *E*. The hole in the hub is bored about .008 inch small for a 6½ inch shaft. When the flywheel is placed on the shaft a wedge is driven into the fissure *F*, which has the effect of springing the hub open sufficiently to allow the hub to slip easily onto the shaft. When in place the clamping bolts are screwed up solidly and then the setscrews, two of which are shown at *C C*, are screwed down against the keys.

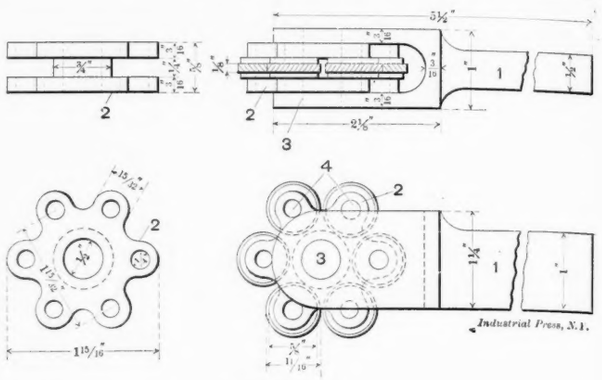
Although this is a somewhat expensive method of keying, it has advantages that undoubtedly warrant its use, being, as already stated, of a permanent character, yet of a nature that permits the easy removal of a hub at any time and without requiring the use of special appliances. M. E. CANEK.

KNURLING TOOL.

Editor MACHINERY:

The accompanying drawing illustrates a knurling tool, devised by a friend, which has the self centering quality of the jointed holder in common use, and the additional convenience of having three sets of knurls, fine, medium, and coarse, in one holder always ready to use.

The shank of the holder, 1, is of 1-inch by ½-inch machinery steel, so as to be used in a lathe tool-post. At the front is a fork in which the star-shaped piece, 2, is mounted on a pin, 3, the pin being fast in the fork, and the piece, 2, turning



Knurling Tool.

on it with a slight friction on the sides of the fork. Three pairs of knurls of the desired sizes are mounted on pins, 4, in the star-shaped piece, and turn freely on the pins.

In use, two knurls of the same grade are set straddling against the work in the lathe, and fed along in the usual way by the carriage feed mechanism.

The advantages of having the several sizes of knurls always ready for use, and not liable to be lost, will be readily appreciated. C. D. KING.

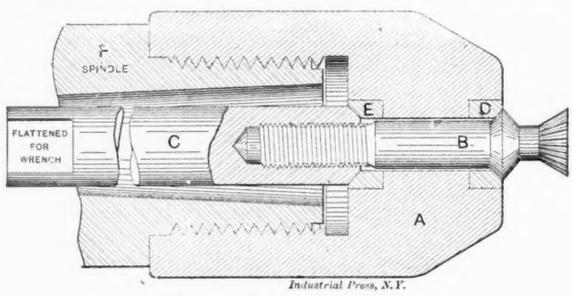
Brooklyn, N. Y.

END MILL HOLDER.

Editor MACHINERY:

The accompanying sketch illustrates one method of holding all forms of end mills in the milling machine spindle. The trouble we had with the ordinary taper shank end mills working out under a cut led to this device which, so far, has given excellent satisfaction.

Referring to the sketch, *A* is a cast iron body threaded to fit the machine spindle *F*; *B* is the end mill, and *C* the nut which draws the angular shoulder on the end mill against the correspondingly turned hardened bush *D* in the front end of the chuck body. The nut *C* extends through the machine spindle and is flattened for a wrench; its front or nut end is case-



Device for Holding End Mills.

hardened and bears on a hardened steel bush *E*, similar to the one in the outer end of the chuck body. The body of the end mill is 1-64 inch smaller than the hole in the chuck so that it is held only by its angular shoulder in front, the conical end of the nut holding the back end perfectly true.

As before stated, this rig works well. The cutters run quite true, never slip, and are quickly put in or removed, and, though the end mills may cost a little more than those with taper shanks, I think this extra expense is offset by better service obtained from the tools. CORNEIL RIDDERHOF.

Grand Rapids, Mich.

ITEMS OF MECHANICAL INTEREST, GATHERED FROM VARIOUS SOURCES.

The man who, for economical or other reasons, shaves himself, usually knows only too well the woes inflicted by a dull razor. A razor that "pulls" is not only highly disagreeable, but is much more likely to cut the flesh than when it shaves easily. To sharpen a razor by honing and stropping is something of an art and one not readily acquired by many masculine unfortunates to whom their hirsute adornment becomes in consequence a source of misery. Recognizing this lamentable condition of affairs, a California genius has investigated the razor subject and has, he alleges, discovered a very simple remedy for all razor ills. It is well-known that the edge of the sharpest cutting instrument, when examined under a microscope, proves to be serrated with fine teeth. The keener the edge, the finer and more regular the teeth, and vice versa. A razor that "pulls" has an irregular edge, some of the teeth being much longer and larger than others. The claim of patent No. 697,529 is that if a magnet is kept in close proximity to the edge of a razor, the edge will be drawn out by the magnetic force and kept keen for a long time without stropping or honing. In the specific form of the invention illustrated a bar magnet is arranged in one edge of the razor case so that when the razor is put within the case, the edge of the blade will be close to the side of the magnet, so as to be constantly within a magnetic field.

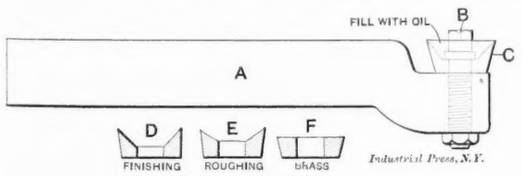
WHY IT IS DIFFICULT TO SOLDER ALUMINUM.

The one great drawback to the application of aluminum for a large number of uses in the arts for which its lightness, color, resistance to oxidation and the ease with which it can be rolled, drawn into wire, pressed and spun up into various shapes, etc., is the difficulty of soldering joints. The reasons why this difficulty is encountered are not generally understood and are explained in the following note from the Journal of the Franklin Institute:

The difficulties encountered are threefold: (1) The high heat conductivity of aluminum, which abstracts heat rapidly from the joint and (2) galvanic action between the aluminum and the metals of the solder by which the aluminum (the more electro-positive metal) is corroded and the joint destroyed. It is comparatively easy to make an apparently perfect soldered joint of aluminum with various mixtures of zinc and tin, for the reason that when freshly made, the adherence is all that could be desired. The effects of the galvanic corrosion may make themselves apparent after the work has been exposed to atmospheric influences for some months. The rapid heat conductivity of the metal can be practically obviated by applying artificial heat to the joint while the solder is being applied. It has been proposed to use aluminum in considerable proportions in the solder to avoid the effects of galvanic action, but while this artifice might accomplish the desired result, the joints cannot be made with the soldering iron, because of the high heat required to melt the alloy. A perfect solder for aluminum is still to be found.

NOVEL LATHE AND PLANER TOOL.

A correspondent of the *English Mechanic* some time ago described an unusual form of lathe and planer tool which is probably chiefly deserving of mention rather because of its novelty than of its utility. The cutters, which are of circu-



Lathe and Planer Tool.

lar form, are bolted to a holder of the shape indicated at *A*. The cutter *C* has a central depression, the sides of which are of the proper angle for the material to be worked. The bolt *B* is threaded in the holder *A* and locked with a nut on the under side. The cross sections *D*, *E* and *F* show the shapes for different materials and for roughing and finishing. *E* is for roughing steel and *L* is for finishing steel. *F* is for brass. The tool is said to throw a perfect shaving and to work equally well whether turning or facing. When it gets dull the bolt is loosened and the cutter turned on the holder until a sharp portion is brought around to act on the work. When dulled all around the cutter is removed and mounted on a mandrel on the centers of a grinding machine and ground to an edge all around. If the bolt holding the cutter is slackened the cutter will slowly revolve as the cut proceeds and in this manner continually present a new and cool cutting edge to the work. This action, however, is not recommended, for reasons not given. The correspondent says that cutters for the heaviest lathes should not exceed 1½ inches diameter.

NOVEL BICYCLE CHAIN COVER.

An English novelty in bicycle chain shields or covers intended to take the place of the ordinary gear case, is illustrated in Figs. 1, 2 and 3. The cover forms a part of the chain and travels with it. It consists of separate shields of thin sheet metal so attached to the links as to cover the tooth spaces. Each shield overlaps its neighbor shingle-fashion, thus making a flexible but practically continuous cover extending the whole length of the chain. Fig. 3 is an end view of one of the shields showing the side legs or extensions for holding the shields to the links. The ends of the legs are turned inwardly to hook over the edges of the links.

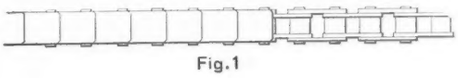
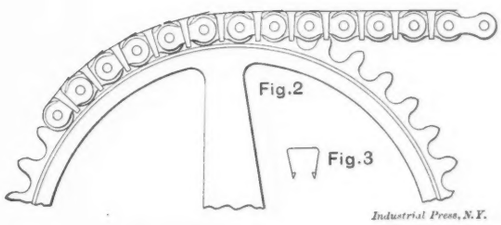


Fig.1



The shields are made of pen steel, and also of tin. When made of steel the legs have sufficient elasticity to spring over the links and retain their position; when made of tin the ends of the legs must be bent over after being placed in position to hold. The shields add nothing to the width of a chain and very little to its weight, the additional weight being less than 2½ ounces in the case of an ordinary bicycle chain. The practical value of this device seems questionable, however, in view of the probability of as much dust and dirt getting on the inside of a chain as on the outside. The dirt sticking to the outside of a chain does not affect its working nearly so much as that getting on the inside surfaces.

WATER WHEEL GOVERNING.

In governing a steam engine by a throttling governor the throttle valve opens slightly when the speed of the engine is reduced, thus admitting more steam at higher pressure, which in turn produces a higher pressure in the engine cylinder and brings the speed of the engine up to its normal point. Also, when the speed of the engine is too high, the throttle valve is closed slightly, cutting down the supply of steam. In water wheel governing the same principle is used, but the results are not as satisfactory, owing to the inertia of the water. The first effect of such opening or closing of the wheel gates is the opposite to that desired for governing purposes. The water in the penstock leading to the wheel is moving at a certain velocity, depending upon the head of water and the size of opening through the water gate. The inertia of this water is so great that when the gate opens, making a larger exit for the water, the velocity in the penstock does not change at once, and as the opening at the wheel is larger, the water has a larger opening to pass through and its speed at that point is momentarily slower than before. On the other hand, when the gate is closed a small distance, the water for the instant continues to flow through the penstock at the same speed, and as it has a smaller opening through which the same quantity of

water must crowd, its speed at the wheel is momentarily increased. These effects, which are the reverse of those desired, continue until the changed conditions can be imparted to the whole body of water and the various forces brought into equilibrium again. This problem of the inertia of the water in water-wheel governing is one that has engaged the attention of many inventors and numerous patents have been taken out upon various devices calculated to offset the effects of this inertia.

QUICK-ACTING VISE.

Under this heading in the June number we published a description of a vise made in England, in which the movable jaw could be quickly adjusted to any position and clamped, the work being drawn down solidly against the base of the vise at the same time that it was gripped by the jaws. The description of this vise has brought to our office the accompanying sketches, showing the quick-acting vise manufactured by the Vanderbeek Tool Works, Hartford, Conn., which is

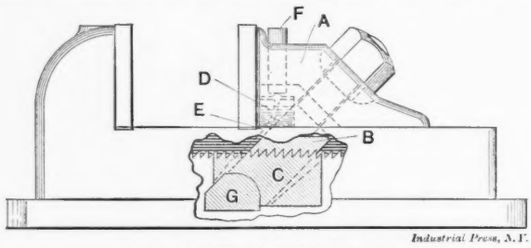


Fig. 1. Details of Vanderbeek Vise.

simpler in construction than the one made by the English firm. We believe the details of this ingenious tool have not previously been illustrated and will be new to such as have not seen or used the vise itself. Referring to Fig. 1, the movable jaw *A* slides on the base of the vise and is clamped by the nut shown, which screws on the threaded portion of the bolt or shank *B*. This bolt has T-head projections, *G*, at its lower end which bear in grooves in the under side of the notched block *C*. Ordinarily this block is held up against the teeth notched in the under side of the base of the vise, by means of the flat spring *D*, shown dotted. A piece of sheet metal, *E*, hooked to the top of the spring *D*, and attached to the block *C*, holds the latter in place ready for the nut to be turned to clamp the work. When it is desired to move the jaw the nut is loosened, and the piece *F* is pushed down, depressing the spring and allowing the teeth of the block *C* to become disengaged. Upon releasing *F* the teeth again mesh and the jaw can be clamped. As the clamping bolt is

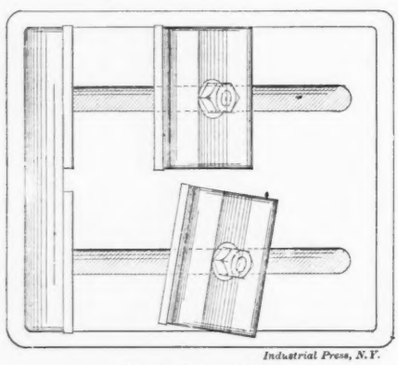


Fig. 2. Planer Vise.

inclined at an angle of 45 degrees, it not only draws the jaw against the work, but draws both the jaw and the work downward. The jaw can be swiveled freely about bolt *B* to accommodate taper work. In Fig. 2 is a sketch showing the arrangement adopted for planer vises, two independent six-inch jaws being used which can be brought into any desired position for holding work of almost any shape that is likely to be met with.

ALLOYS FOR HYDRAULIC CASTINGS.

A list of the alloys, which on account of their possession of the requisite tensile strength are suitable for making hydraulic castings, is given by E. S. Speery in the *Aluminium World*. They are arranged in the order of their value for the purpose, and commence with the alloy best adapted for the work:

1. Phosphor-bronze (free from lead and zinc).
2. Phosphor-bronze with small amount of lead.
3. Gun metal (copper, tin, zinc).
4. Composition and steam metal (copper, zinc, tin).
5. Yellow brass with or without tin and lead.
6. German silver.
7. Manganese bronze.
8. Aluminum brass.
9. Aluminum bronze.
10. Aluminum.

The formula for making phosphor-bronze sand castings to resist hydraulic pressure, is as follows:

	For a Tough Alloy.	For a Hard Alloy.
Copper	90.00 per cent.	87.50 per cent.
Tin	9.75 per cent.	12.25 per cent.
Phosphorus	.25 per cent.	.25 per cent.

If phosphor-tin is used which contains 5 per cent of phosphorus the proportions are, viz:

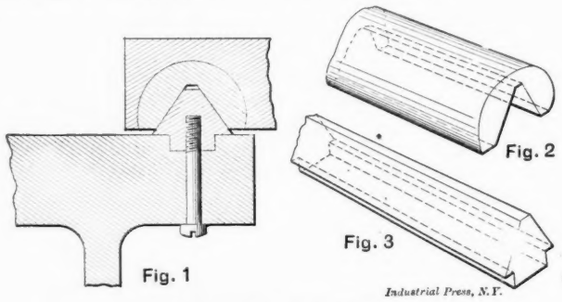
	For a Tough Alloy.	For a Hard Alloy.
Copper	9 pounds.	8¾ pounds.
Tin	½ pound.	¾ pound.
5 per cent Phosphor-tin	½ pound.	½ pound.
	10 pounds	10 pounds.

If a casting made of phosphor-bronze only leaks slightly under pressure it may sometimes be stopped by drying out the water, and heating and soaking it in melted paraffine.

LATHE AND PLANER HARDENED AND GROUND WAYS.

A recent invention relating to lathes, planers and all other classes of machinery constructed with sliding surfaces has been patented by J. L. Osgood, Erie County Bank Bldg., Buffalo, N. Y., who has been engaged in the machinery business in Buffalo for several years past. The invention consists of inserting in the bed of a lathe, planer or other machine hardened steel or other metal guides, slides or v's, and accurately ground, which take the place of the ordinary soft cast iron guides.

It is a well-known fact that all wearing parts of lathes have been improved in construction in recent years to lessen the wear and maintain the accuracy, except the one most important point, the carriage guides or v's, and these, as it is well known, wear rapidly, and are frequently abraded and damaged by dropping tools and work upon them.



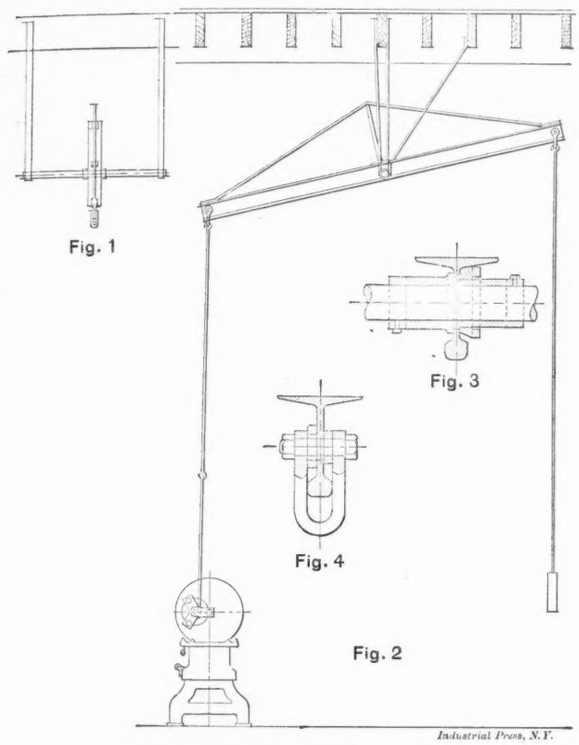
Hardened Ways for Lathes.

In Fig. 1 is shown a cross section of a V-guide inserted in a lathe bed and the corresponding slide inserted in the carriage. In Figs. 2 and 3 are separate views of the carriage slide and the V-guide respectively, and the method of inserting and holding in place are clearly indicated. Mr. Osgood writes that the system has been thoroughly tested and found commercially practicable. A 15-inch lathe recently completed has guides that can hardly be touched with a file, and have been ground to very close limits of accuracy. By having the ways rolled nearly to size in bars and with improved grinding facilities, it is expected that the construction will not cost more than the ordinary soft iron "V's." The hardened shoes will probably not be inserted in the carriages of regular manufacturing lathes, as such a refinement would hardly be warranted except in the case of tool room and precision lathes, where every reasonable provision should be taken against wear.

CRANK SHAFT COUNTERBALANCE.

Commander A. F. Dixon, U. S. N., contributes to the *Journal of the American Society of Naval Engineers* a description of a walking beam counterbalance used at the Mare Island Navy Yard in turning crank pins. The device was designed by W. G. Luper, first-class tool maker, and has the advantages that the counterbalance weights are easily adjusted and act in a way to relieve the lathe centers of their load, rather than otherwise.

Many launch engines are built at the Mare Island Navy Yard, and the crank shafts, being light, can be more easily and cheaply done in a lathe whose face plate is not sufficiently large to carry a suitable counterbalance; particularly is this the case with three-throw shafts.



Counterbalance used in Turning Crank Shafts.

In order to do this work properly in a lathe of suitable size the walking beam counterbalance was constructed in the steam engineering shops of the navy yard. It consists of a walking beam 10 feet 10 inches long, made by trussing a piece of 6-inch deck beam with a strap ⅜ inch by 2 inches. It has in its center a properly constructed bearing, through which is passed a 2-inch shaft of sufficient length to admit of any required movement of the beam parallel with the lathe. The shaft rests in strap hangers secured to the timbers above, each hanger having a brace secured to the timbers and bolted at the lower end by a bolt that passes through the hanger, shaft and brace. At each end of the beam is a bearing for the attachment of a clevis from which detachable hook rods are hung. A weight, sufficient to balance the shaft to be turned, is secured to one of these rods, the rod being of such length as to suspend the weight but slightly above the floor. The shaft is rough turned and the crank webs removed before work upon the crank pins is begun.

The beam having been adjusted upon its shaft, the required weight attached, the broad hook is passed under a turned portion of the shaft and the lathe is ready.

Referring to the accompanying sketches, Figs. 1 and 2 are elevations showing the beam and beam shaft as attached to the timbers of the second floor. Fig. 3 is a detail of the center bearing, and Fig. 4 a detail of the clevis bearings.

* * *

The **Great Northern Railway** is building new locomotive shops in **St. Paul, Minn.**, at a total cost of about **$180,000.** The work is being pushed rapidly as it is desired to occupy them in the coming fall.

A COOLING MACHINE.

Prof. Willis L. Moore, Uncle Sam's chief weather clerk, evidently has not been uniformly successful with his weather predictions and has found to his sorrow that he could not always deliver the kind of climate desired by his patrons. He has now come out in open defiance of the elements by inventing a cooling and drying machine, through the use of which a person may secure a taste of winter in summer, without regard to climatic conditions.

The mere matter of producing a cool atmosphere during the hot weather in a building or compartment is not difficult. It is done every day in refrigerating plants, in our ice chests and in our cellars. Except in the very driest climates air thus cooled is extremely unhealthy, however, inasmuch as it has a high degree of humidity; and while it may be at a low temperature as shown by the thermometer, it is not necessarily more agreeable to the human body than a warmer but drier air would be. One's comfort in warm weather depends more upon the humidity than upon the temperature of the atmosphere, since the perspiration from the pores of the skin is not easily absorbed by an atmosphere which already contains a large amount of moisture. The problem, then, in making a room or building more habitable in warm weather, is not so much to reduce the temperature of the atmosphere as to reduce its humidity, and this Prof. Willis claims to have accomplished through the invention of an apparatus which he is about to patent and place on the market. As yet no particulars can be obtained about the principle of the apparatus, and we do not know what absorbent agent is employed to reduce the humidity. In a descriptive circular the following particulars are given:

To operate a machine capable of cooling a large room containing, let us say, 5,000 cubic feet of space, would cost about fifty cents for twelve hours, or one dollar for twenty-four hours. To operate a machine capable of cooling a space containing 12,000 to 15,000 cubic feet, would cost about one dollar per twelve hours or two dollars for twenty-four hours. As there is some ice used in the machine these figures are based upon ice costing $5 per ton. The large machine has a vertical cylinder 8 feet high and 2 feet 5 inches in diameter. The machine stands on an iron support 2 feet high and requires about 2 feet of space at the top for charging. The small machine will have a cylinder 6 feet high and 2 feet in diameter, with attachments at the top and bottom requiring about 2½ feet of space. The machine will be constructed of copper or galvanized iron, and can be easily moved from room to room, as the metal is thin and the weight is not great. There is a constant current of air flowing through the machine, entering at the top and passing out at the bottom, and impelled by an electric fan.

* * *

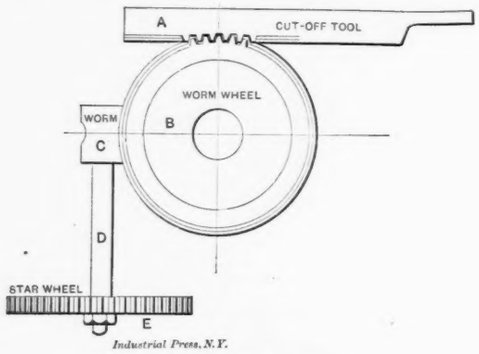
INTERESTING CUTTING-OFF DEVICE.

The pipe machine is one that is usually subjected to neglect and abuse, yet wherever one is bought it is expected to go on indefinitely cutting accurate threads until the "oldest inhabitant" can scarcely remember when it was new. To design such machinery so that it can be made and sold at prices considered fair by the buyers thereof, is by no means an easy matter; the elements of cheapness, practicability and durability cannot usually be juggled together without the expenditure of considerable "gray matter." It is then not surprising that often we find in such machinery, schemes and devices that are very interesting examples of design.

A case in point is the cutting-off device of the Forbes pipe die-stock made by the Curtis & Curtis Co. While this unique machine may be and probably is quite familiar to most mechanics it is also quite probable that most of them are not familiar with the details of the tool for cutting off the pipe. The problem involved in its design was to get a compact slide to carry the cutting-off tool and to have the parts amply strong to resist the strains that would inevitably be imposed on it. If the cutting-off device were stationary, as in machines revolving the pipe, it would not have been a difficult matter to design an ordinary cross slide for the purpose; but as it was to revolve with the die head around the pipe, it was an entirely different problem. An ordinary slide would

necessarily be of small dimensions and as its bearing surface would be limited, it would soon wear and become shaky. The matter of attaching a tool to the slide so that it could be readily removed for grinding and replaced in proper location, was another problem of considerable difficulty.

The way the matter was finally solved was to have no slide at all or rather to make the cutting-off tool act as its own slide. A tool, say 6 inches long, is ⅜-inch thick and 1½ inches wide. It is closely fitted in a rectangular slot in the die-head at right angles to its axis. No screw is used to feed



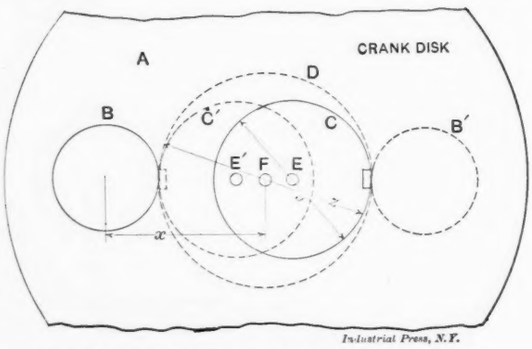
Cutting-off Mechanism.

the tool to the work. Instead one side of the outer end is cut with rack teeth of about ¼-inch pitch, in which mesh the teeth of a gear or rather of a wormwheel. Consequently the teeth of the rack are not at right angles to the axis of the cutting-off tool but are inclined slightly to conform with the angular pitch of the wormwheel teeth. The wormwheel is driven by a worm mounted on the same shaft with a star wheel. The arrangement is shown diagrammatically in the accompanying cut. *A* is the cutting-off tool, looking at the narrow edge; *B* is the wormwheel; *C* is the worm, and *E* is the star-wheel, which strikes one or more stationary tappets attached to the frame of the machine when cutting off a pipe. The arrangement is neat and compact and wears well.

* * *

SHAFT SEAT FOR ENGINE CRANK DISK TURNED ECCENTRIC.

While on a recent short tour of inspection of some of the machine shops near New York City, the writer called at the works of Ball & Wood, at Elizabethport, N. J., and there, among other interesting things mechanical, saw a vertical compound condensing engine being built for the South Bend, Ind., shops of the Singer Manufacturing Co. This engine is of the same general style as those already built by Ball & Wood for the



Showing Relative Position of Shaft, Disk and Crank-pin.

other power plants of the Singer Company. The valve gear is of the four-valve Corliss type, with two eccentrics for each cylinder and flywheel governors. The high-pressure cylinder exhausts into the low-pressure cylinder through a reheater attached to the side of the frames, in a horizontal position. The crankshaft is of the type having overhanging crank disks at each end. The flywheel and armature of the generator are located in the middle section.

The distance between the two bearings is long, which necessitates a large diameter of shaft to prevent excessive deflection in the center, due to the weight of the flywheel and armature. Because of the large diameter shaft and the short stroke of the cylinders (18 inches) there would not have been sufficient metal in the crank disk between the crank-pin hole and the shaft hole to stand the stress of a press fit, if made in the ordinary manner. In fact, almost all the metal would have been cut away. So it was necessary to resort to a rather unusual expedient in stationary engine practice to get sufficient metal in this spot. The bearing or seat for the crank disk was turned eccentric to the axis of the shaft sufficient to throw it out of center, away from the crank-pin about 1½ inches. The seat was also, of course, turned smaller in diameter than the shaft, and in this manner a thickness of about three inches was gotten between the two holes. The crank disks being made of cast steel, this amount of metal sufficed.

In the cut *A* is the crank disk, *B* the crank-pin, and *D* the shaft. One-half the stroke is represented by the distance *x*, the diameter of the shaft by *z* and the diameter of the eccentric seat by *y*. The crank-pin for the cylinder at the opposite end is located at an angular position of 180 degrees so that its position is represented by the dotted circle *B′*, and the seat for its crank disk by the dotted circle *C′*. There are, therefore, three centers on the ends of the shaft from which it is swung when turning. *F* is the main center used in turning the body of the shaft, *E* is the center for the eccentric part *C*, and *E′* is that for the part *C′*.

The Westinghouse Machine Co. have used practically the same expedient on their 6,000 H.P. superheated steam engines built for the Edison Waterside station in New York. In this case each engine crank shaft has three cranks with journals on each side of each crank.

* * *

WRITING FOR TECHNICAL PAPERS.

"Progress" writes that he believes there is nothing which will cause a young man, or an older one, either, to take more interest in his work than writing for a good technical paper, and he gives five reasons why it will prove helpful to a man, as follows:

First—It causes him to take more notice of things about him in obtaining subjects to write upon, and by examining the details he will learn the use and effects of many forms and motions that he would never notice otherwise.

Second—By close examination he will often see where an improvement can be made either in the forms or in the method of making, or both.

Third—The examination of things about him creates a desire to get out and look for other things that he has never seen or that he did not understand the operation of.

Fourth—It causes him to read more, so he may learn where to find new material and what to look for.

Fifth—His employers will observe that he takes an interest in his work, will advance him, giving him better work and more pay, and he will be looked up to as an authority on many things; and, lastly, the financial benefit obtained for the written article is not to be despised.

What I consider an excellent way to gather material to write upon is to carry a note book and pencil in the pocket, and whenever anything of special interest is noticed make a short note of it, and when convenient make a thorough examination of it. Then, when enough material is obtained, it can be formed into an article for publication.

* * *

Another lost art is reported to have been discovered. This time it is the art of making malleable glass which is alleged to have been known by the ancient Egyptians. A glass lamp chimney worker of Richmond, Ind., is said to be able to make glass articles that will stand high temperatures without breaking, even when suddenly cooled by having cold water dashed over them. Heavy glass bottles treated by the process were tested by being filled with cold water and placed in a hot fire where the water was entirely evaporated without the bottles being harmed. One important use predicted for glass utensils made by this process is for cooking purposes. Glass pots and other cooking dishes could be used instead of iron or other metals of a corrosive nature.

NEW TOOLS OF THE MONTH.

A RECORD OF NEW TOOLS AND APPLIANCES FOR MACHINE SHOP USE.

ELECTRICALLY-DRIVEN HAMMER.

The Stow Flexible Shaft Co., Philadelphia, Pa., have brought out a novel hammer to be used for chipping, calking, riveting, and any work similar to that done by a pneumatic hammer. Power is supplied by a small electric motor which drives the working parts of the hammer through a Stow flexible shaft.

Fig. 1. Motor Driving a Chipping Hammer through a Stow Flexible Shaft.

Wires connecting the hammer with the motor enable the operator to start and stop the motor by means of a push button in the handle of the hammer, the motor being started and stopped whenever it is desired to start and stop the hammer action.

While the hammer is designed to accomplish work similar in character to that done by a pneumatic hammer, it can be installed and operated at much less cost and will be available in any plant having an electric light circuit. The current required for the motor is about the same in amount as required for operating an ordinary fan motor.

The hammer is made in several sizes. The illustration, Fig. 1, shows the medium size in the hands of its operator and gives an idea of the proportions of the motor and hammer. An exterior view of the hammer appears in Fig. 2 and in Fig. 3 is a sectional drawing representing the working parts. Power is transmitted to a crankshaft, *A*, in Fig 3, by means of the flexible shaft, and a reciprocating motion is given to the hammer head *C* by the pitman *B*. As the rotation of shaft *A* is very rapid the succession of blows upon the chisel is so rapid as to be almost continuous. A small balance wheel on the end of shaft *A*, the casing of which is visible in Fig. 2, absorbs part of the shock of the impact and produces smooth running. The connection between the pitman and hammer head *C* is flexible. A plunger *D* is free to slide within the hammer head, but is kept from striking point *F* by the coil spring at *E*. When the pitman moves to the right its right-hand end presses against the plunger at *G*, which in turn communicates motion to the hammer head through spring *E* and the chisel is struck a sharp blow.

After the blow has been delivered the hammer head is returned to its original position by the movement of the pitman to the left, by means of pin *g*. This pin is attached to hammer head *C*, but is entirely independent of the plunger *D*.

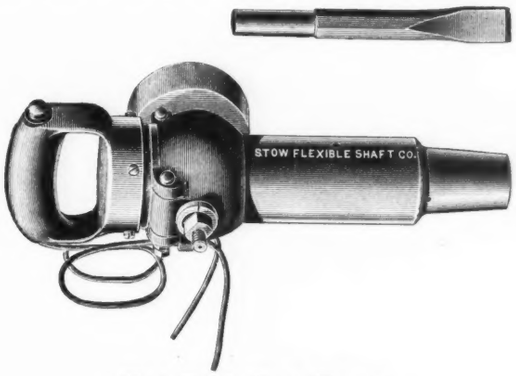


Fig. 2. Exterior View of Hammer.

The end of the pitman is slotted to receive pin *g* and the slot is of such a length that the pin, together with the hammer head, can have free motion during the blow; but upon the movement of the pitman to the left the end of the slot comes in contact with the pin and pulls the hammer head back ready for the next blow. The chisel is supported in a socket *S*, backed by a spring as shown. This makes a flexible connection between the chisel and hammer body, enabling the chisel to receive the full force of the blow. There is also a spring, *K*, between the handle and body of the hammer to reduce the vibration felt by the operator. The electrical connection with the motor is made by the push button *L*.

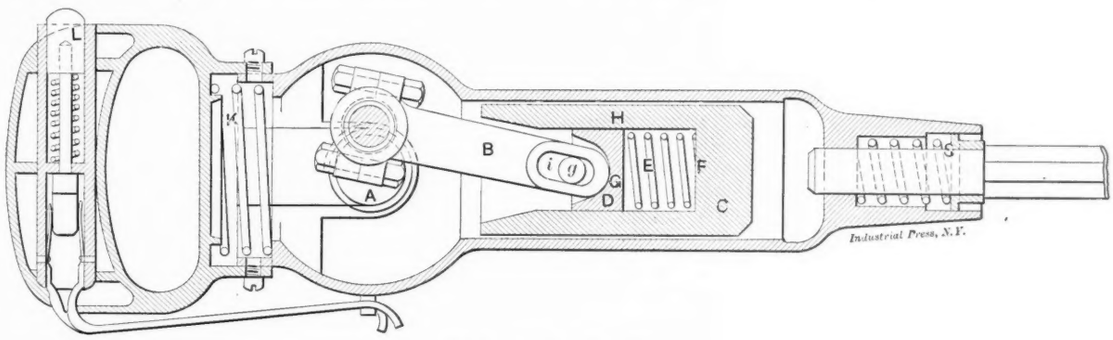


Fig. 3. Details of Hammer.

NEW BENCH PLANER.

The bench planer shown on page 368, recently put on the market by E. E. Bartlett, Boston, is a larger size of the planer previously built by him for light manufacturing and for jobbing shops. The new planer weighs nearly double and is a much more substantial and better designed tool. It will plane work 10 inches wide, 10 inches high, and 30 inches long. The table, including the pockets, is 36 inches long and is gibbed down to prevent lifting. It has three T-slots cut from the solid, and four rows of ½-inch holes, drilled and reamed. The machine is driven by two belts, one on each side, operating a train of cut gears, whose pinions are of steel. The driving pulley is 8 inches in diameter by 1 inch face, and the ratio of belt travel to cutting speed is 36 to 1, which is ample to take a ¼-inch chip from cast iron.

The head has an automatic cross feed in either direction, has a graduated swivel, and can be set at any angle and locked

in the usual way. The screws and shafts are of steel, case-hardened wherever advisable, and the handles and balances are of steel, to secure the necessary strength with suitable proportions.

One of the good features on this machine is the shifting mechanism of the belts, which motion operates one belt ahead of the other, thus eliminating the dragging and squeaking

Bartlett Bench Planer.

incident to having two belts on the same pulley at once. The countershaft is fitted with tight and loose pulleys, 5 inches diameter and 2 inches face, together with two pulleys for driving and for return. There is a crank handle in front for running the planer by hand and the change is easily made.

COMBINED BORING AND MILLING MACHINE.

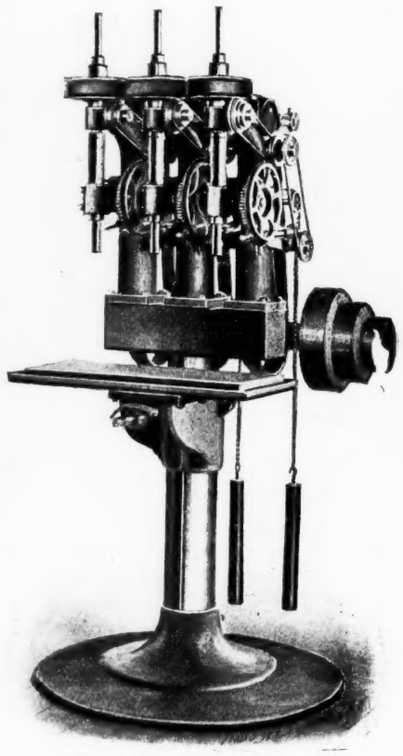
The machine shown herewith is of a new combination boring and milling machine recently gotten out by the Beaman & Smith Co., Providence, R. I. The special work the company had in mind in constructing this machine was the boring of small cylinders having a frame attached at one end, which must be finished true and at a right angle with the bore; and also the facing of the cylinders at one end and the finishing of the frame.

The machine consists of a substantial bed on which at one end is the driving mechanism for the boring spindles. There are two of these spindles so that two cylinders can be operated upon simultaneously. A fixed base supports two heads, each carrying a spindle for boring purposes and provided with horizontal adjustment, so that the distance from center to center of spindles, or spread, can be changed as required. The work table or carriage is provided with automatic feed, and holds the work in suitable fixtures. Attached to the carriage and placed at a right angle to its movement on the bed is a base carrying a saddle with a spindle for milling purposes, and suitable drilling mechanism for it, automatic feed and stop being provided for the saddle.

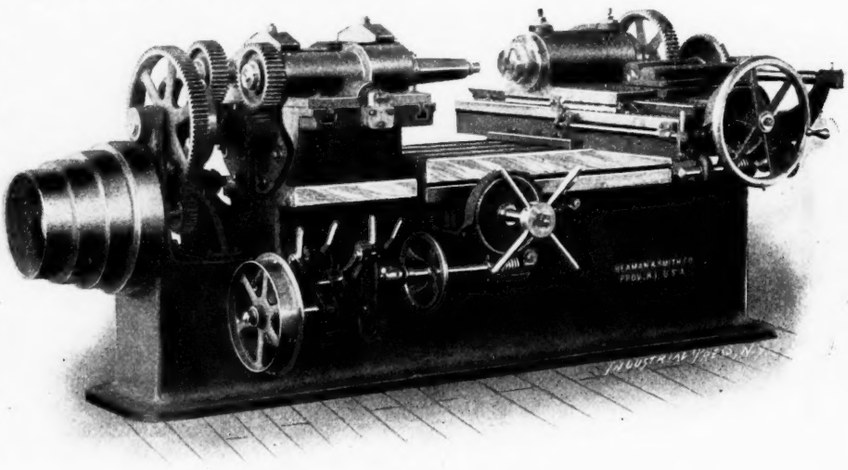
The combined movements produce the desired results of boring the cylinders and at the same time milling the frame or base, and thus greatly reduce the cost of production. The machine is of substantial design and construction throughout.

THREE-SPINDLE DRILL.

A multiple-spindle drill press with power feed and automatic stop, designed especially for use in manufacturing duplicate pieces, is shown below. It is built to drill from 0 to ⅝-inch holes and to the center of 14 inches, and is made with two, three or four spindles on the column and five and six spindles on a base or table on legs. All the spindles run at the same speed but the machine has three changes of speed. When power feed is used the machine can be set to drill any depth from 0 to 5 inches and will stop automatically, the spindles flying back to position. Each spindle is independent and has three changes of feed. The No. 2, illustrated in the figure weighs, with countershaft complete, 1,200 pounds. Its principal dimensions are: Distance from column to spindle, 7½ inches; greatest distance from spindle to table, 28 inches. These drills are manufactured by the Norton & Jones Machine Tool Works, Plainville, Conn., who are also prepared to furnish any of the various drill chucks that may be desired for use with the drills.



Norton & Jones Three-spindle Drill.



Beaman & Smith Boring and Milling Machine.

NEW SETTING INSTRUMENTS FOR MACHINISTS

Figs. 1 and 2 illustrate a new setting instrument for machinists' use. It consists of a body containing a spirit level, the bubble of which appears through an elongated opening formed in the top plate, attached to the body and provided

at its side with linear graduations having their zero points coinciding with the zero point of the bubble. The body is provided with a downwardly extending web terminating in legs, extending at an angle of 150 degrees and having their apex in vertical alignment with the bubble of the spirit level. The outer faces of the legs are provided with linear graduations, reading from the apex outwardly.

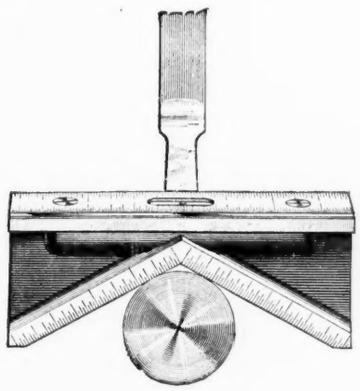


Fig. 1.

Fig. 1 shows the instrument on the shaft and the tool in position in the tool post ready to cut a keyseat. For setting a square nose tool in the shaper or planer, to cut a keyseat or groove, the operator places the instrument upon the shaft with the legs touching the sides of the shaft and turns the instrument until the bubble of the spirit level is at zero. The planer tool is then brought to the correct position by aid of the graduations and is set with its edge parallel with the top surface of the instrument.

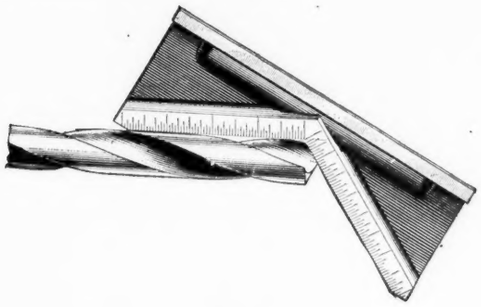
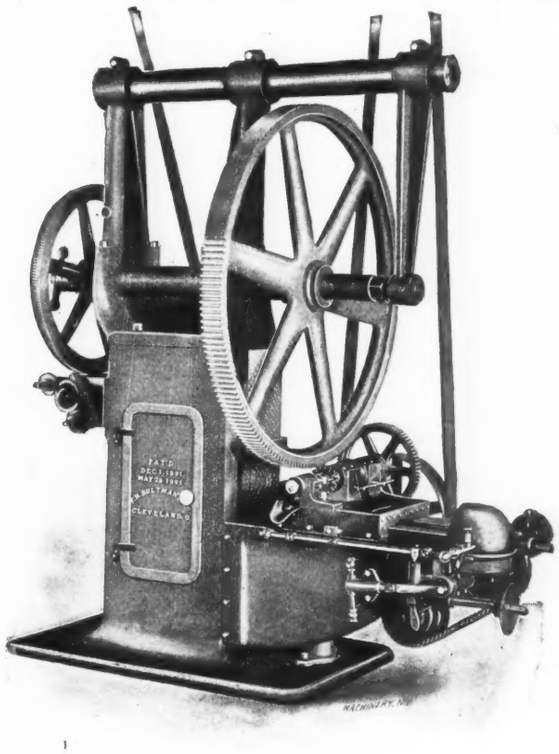


Fig. 2.

Fig. 2 shows the instrument used on a twist drill. To grind twist drills to the proper angle, place the drill parallel and against the left-hand leg to bring the cutting edge parallel with the other leg. Note the length of one cutting edge by the graduations, then turn the drill half way round to get the length of the other cutting edge, and continue turning the drill and grinding the edges until they are the same length. This instrument is the invention of Morris Chamberlain, Bartley, N. J.

BULTMAN GEAR CUTTER.

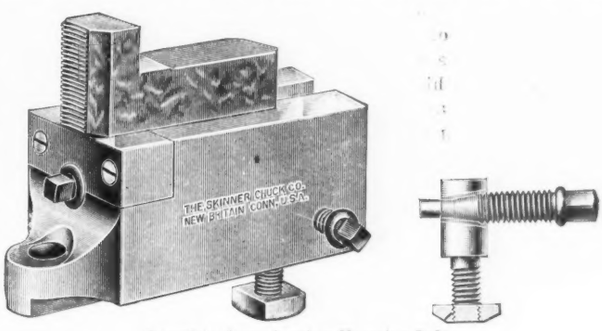
The increased demand for heavy steel gears has necessitated the reconstruction of automatic gear cutters to adapt them for such work and the latest machine, produced by F. H. Bultman & Co., Cleveland, O., for cutting steel gears is shown in the half-tone herewith. The machine is fully automatic, and will cut gears from a pinion 4 inches in diameter to a gear 50 inches in diameter. It has ample strength to cut a 2-inch pitch steel gear from solid stock in two cuts (the first cut being made with a stocking or common roughing cutter) or in one cut if cored out and free from sand. The cutter has a horizontal movement of 15 inches; the cutter spindle is of special tool steel with a bearing of 10 inches in a phosphor bronze bushing and well supported on the outer end. The cutter is "centered" by means of a nut on the bronze bushing, doing away with collars or all other cumbersome devices for centering. The knee has a vertical movement of 28 inches by means of the elevating screw carrying a large disk graduated to one-thousandths which can be turned to the zero line at each setting. The arbor that carries the blank is strongly supported on the outer end by a sleeve from the 5-inch supporting bar at the top. This arrangement enables the ready and free placing of blanks on the arbor by swinging the sleeve aside, which leaves the whole front of the machine open. The arbor has a No. 5 Morse taper and is drawn in and ejected by a screw running through the work spindle and at the rear of the machine. The blank when partly cut can be turned in any desirable position for inspection without disengaging the dividing worm gear from the worm—a feature that will be greatly appreciated. This can be done in less than one minute. A patented safety device prevents the cutter from entering the work unless the same is accurately spaced, though the whole machine may be in operation continuously. If the machine is properly set at the beginning, the spoiling of blanks is impossible.



Automatic Gear Cutter for Heavy Steel Gears.

FACEPLATE JAWS.

The Skinner Chuck Co., New Britain, Conn., have brought out a line of faceplate jaws for use on lathe faceplates, boring mill and drill press tables, etc. These are made in several different sizes and are a satisfactory substitute for chucks on large machines. The style shown in the figure has a special clamping device for attaching to the faceplate, which is very convenient, especially if the jaw is to be used near the center of the plate. To attach to the faceplate the nut on the vertical bolt is adjusted to the T-slot and the jaw placed in position on the faceplate and fastened by a slight turn of the



Faceplate Jaw, showing Clamping Bolt.

nut, projecting from the side of the jaw near the inner end. With this style of jaw it is not necessary when holding work on the plate to have the adjustable jaw overhang, as there is no projecting lug to interfere with the work. The same style of faceplate jaw is made with a projecting lug at each end to bolt to the faceplate in the usual manner, if preferred. The tongue on the bottom of the jaws is made wide enough so that it can be finished to fit the slot in the faceplate; and if desired they will be furnished with a recess in the bottom, for keying to the faceplate, or they can be drilled and tapped to receive bolts on the bottom side when the plates have no T-slots.

PLAIN GRINDER.

We herewith illustrate a plain grinder which in some respects differs from the conventional form of this class of machines and appears to have some especially good features. The wheels are 24 inches apart, giving plenty of elbow-room for a man at each wheel; and simple, quickly adjustable and removable shields over the wheels help to keep grit from striking the eyes. The bearings, unusually long, reach close to the pulley and wheel flanges, insuring ample support for the spindle and absence of vibration when running. The wrench fits all nuts and screws on the machine and is fastened with a chain to keep it where it belongs.

The column is of a design that allows close approach to the wheels, which is a great advantage to the operator.

The waterpan swings into the column when not needed and leaves the front of the machine entirely clear.

Wilmarth & Morman Grinder.

The countershafts furnished with these machines are also of improved form, self-contained, to facilitate putting up; long in the bearings and the loose pulley is oiled through a hollow shaft. The belt-shifting arrangement is the same as that used on the overhead countershaft furnished with the "New Yankee" drill grinders.

These grinders are furnished by the Wilmarth & Morman Co., Grand Rapids, Mich., and the grinder head without the column can be furnished, if so desired.

MACHINISTS' TOOLS.

The illustrations, Figs. 1 and 2, are of new machinists' tools that have been placed on the market by the Massachusetts Tool Co., Greenfield, Mass. Fig. 1 shows a depth gage with rule which is somewhat like the regular type of depth gage with narrow tempered steel rule, but has additional features. By turning the knurled nut on the back the rule can be loosened and swiveled so that it will be parallel with the base, making it convenient to carry in one's pocket or to place in a corner of a tool chest. The side of the head is graduated into 30, 45 and 60-degree angles and the rule can be turned and clamped so as to conform to any of these lines, making a convenient bevel square. It may also be used as a small T-square.

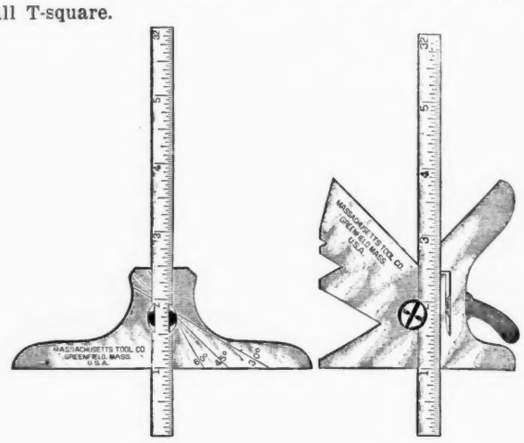
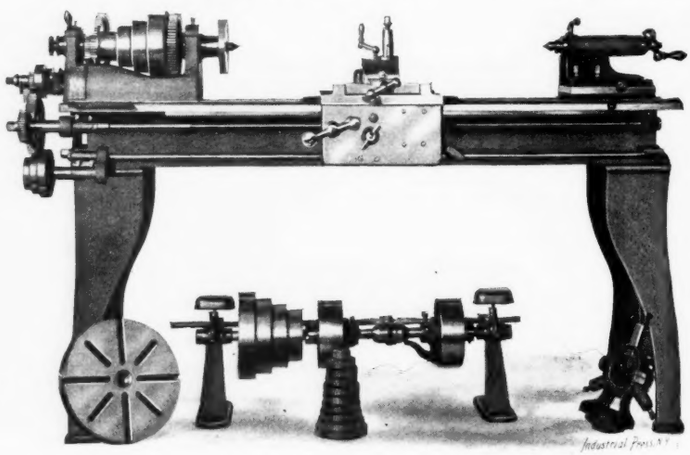


Fig. 1. Fig. 2.

Fig. 2 shows a steel center square with rule, which is a light but very rigid tool. It may be used as a center square, center gage, depth gage or T-square. The rule is easily removed from the head. The head itself lies perfectly flat on one side of the work. The tool is small and light enough to be easily carried in one's pocket. The aim in producing these two tools has been to dispense with needless weight and space.

THIRTEEN-INCH LATHE.

A 13-inch lathe, of new design throughout has been placed on the market by the Worcester Machine Jobbing Co., Worcester, Mass. This lathe is intended to be a substantial and well-built tool adapted either for manufacturing or tool-room



Thirteen-inch Lathe.

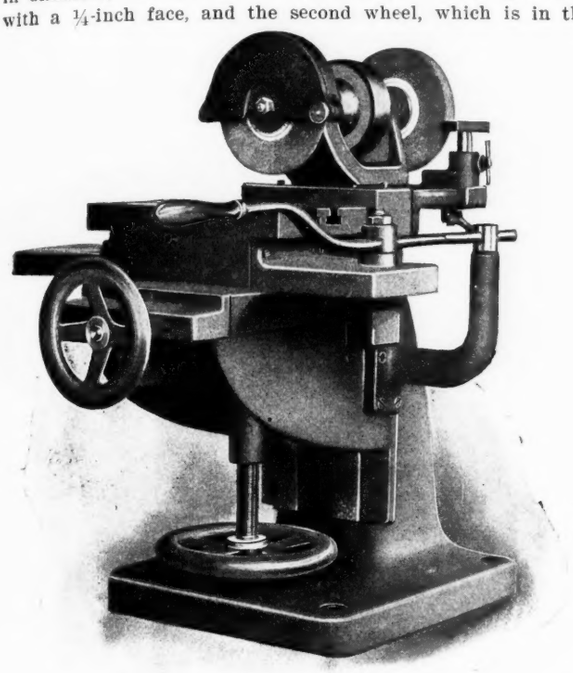
use and has a wide range of capacity. It swings 14 inches, has raise and fall rest, either plain or compound, with power cross feed. The bearings are large, the front one being 1⅞ by 3⅝, and the hole through spindle is 13-16 inch diameter. The bed is made either five or six feet long, as desired, and the European style of headstock is furnished unless otherwise ordered. The lathe cuts threads from 5 to 40 per inch, spindles have No. 3 Morse taper for centers. The shipping weight is 1,125 pounds.

TOOL AND SURFACE GRINDER.

The Cleveland tool and surface grinder, made by the Cleveland Machine Screw Co., Cleveland, O., and shown in the accompanying illustration, is designed for the general pur-

poses of such a machine. It is adapted to tool room use for surface grinding and it will be found to be useful in connection with groups of screw machines, either hand or automatic, for grinding, circular or flat forming tools, etc. Also for grinding punches and dies such as are used in sheet metal stamping. The table has vertical and horizontal adjustments and the feed is by means of a hand lever.

Each machine is provided with two emery wheels 6 inches in diameter, one of which is for surface and tool grinding, with a ¼-inch face, and the second wheel, which is in the



Grinder for Accurately Surfacing Work, Grinding Formed Cutters Etc.

rear, is of the proper grade of emery for ordinary tool grinding, such as lathe tools, drills, dies, etc. It can be furnished with or without base. The base is of the enclosed pattern and provided with two shelves for the accommodation of tools, cutters, etc.

The slide has a longitudinal movement of 6½ inches, and a transverse movement of 2 inches. The distance from the bottom of the 6-inch wheel to the top of slide when the knee is at its lowest position is 4½ inches; and when in its highest position, 0 inches. The height of spindle from the floor when the machine is on a base is 45 inches. The same care is exercised in the construction of the machine that is given in the manufacture of the automatic screw machines made by this company.

BRASS LATHE.

The accompanying illustration of a turret brass lathe shows a design recently perfected by the Dreses Machine Tool Co., Cincinnati, O., a number having just been completed for a manufacturer of brass goods. The lathe is universal, 15-inch swing, and is fitted with all attachments such as cutting-off rest, slide rest and chasing attachment.

The headstock is friction back-geared and the spindle is fitted with a special automatic chuck so arranged that the work held in a special fixture can be unscrewed from the cup-shaped end of the spindle and transferred to another lathe without taking it out of the fixture.

The turret is of the set-over type, provided with screw stop gages for length and cross movements. The top slide can be operated either by the turnstile, or the screw at the rear end of the slide. The turret revolves semi-automatically, which means that the locking bolt withdraws from the index ring at the return stroke of the top slide.

The head end of the bed is supported by a cabinet with several shelves and serves as a tool receptacle. The tail end leg is attached in a swivel manner, giving a three-point principle support for the whole machine.

MACHINE VISE.

A machine vise for use on planers, milling machines, shapers and drill presses has been brought out by the Hill Tool Co., Anderson, Ind. The vise is the result of the needs of their own shop where they have had occasion to use machine vises. A number of styles that they have tried had

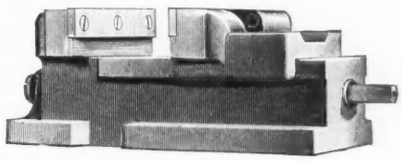


Fig. 1.

proved unsatisfactory on account of the lifting tendency of the sliding jaw, which necessitated driving the work down against the bottom of the vise, and also produced chattering. The principle of the new vise is clearly shown in the detail view, Fig. 2. The movable jaw is operated by a screw and nut, and the connection between the nut and the jaw is such

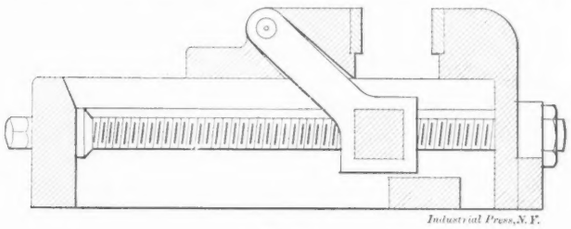
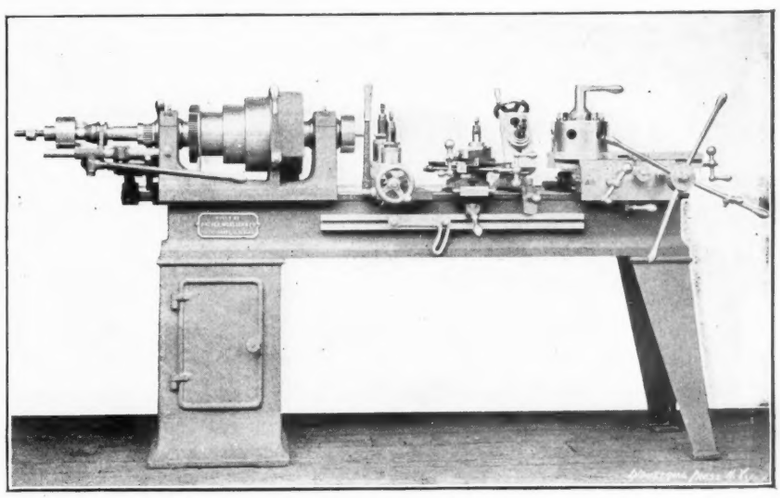


Fig. 2.

that the nut is always in advance of the latter, thus drawing the jaw down to the base of the vise the moment the work is clamped. All parts of the work and vise are thus bound rigidly together as if one piece, and all chattering in the vise is done away with.

DRY GRINDER.

Hill, Clarke & Co., Chicago, Ill., have just placed on the market the Chicago dry grinder, which embodies several distinctive features. The column and head are cast in one piece, giving solidity and compactness; and there is a web cast within the column which connects the bearings on either



Turret Brass Lathe.

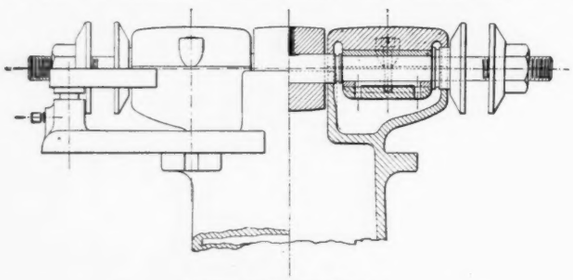
side but curving out enough to clear the belt on the driving pulley. These features not only produce rigidity, but give a pleasing outline to the machine.

The bearings of the grinder are dust-proof and no dirt or emery can find its way to the bearings either in running or in the act of oiling. The arrangement of the spindle and

bearing with the oiling device is shown clearly in the line cut below. The small annular groove in the spindle at either end of the bearing surface, but inside the cap, stops the advance of dirt along the spindle and retains the oil in its proper place. There are no oil holes in the cap through which dirt might enter, but the oil cup is placed below the spindle and opens directly into the oil receptacle, which is

Hill, Clarke & Co. Grinder.

cored out in the column. A wick rising from this receptacle passes underneath the journal and is in contact with the shaft for several inches. No grit can mount the wick, so that even should some be introduced with the oil it would be harmless. One oiling lasts three months. A



Detail of Grinder Head.

pan with water pot is bolted to the column but the machine will be furnished without this if preferred. The two usual rests for the work are provided. The grinder is made in the 12-inch and 16-inch sizes and a 20-inch machine will soon be added.

BRIEF NOTES.

NEW SLITTING SHEAR.

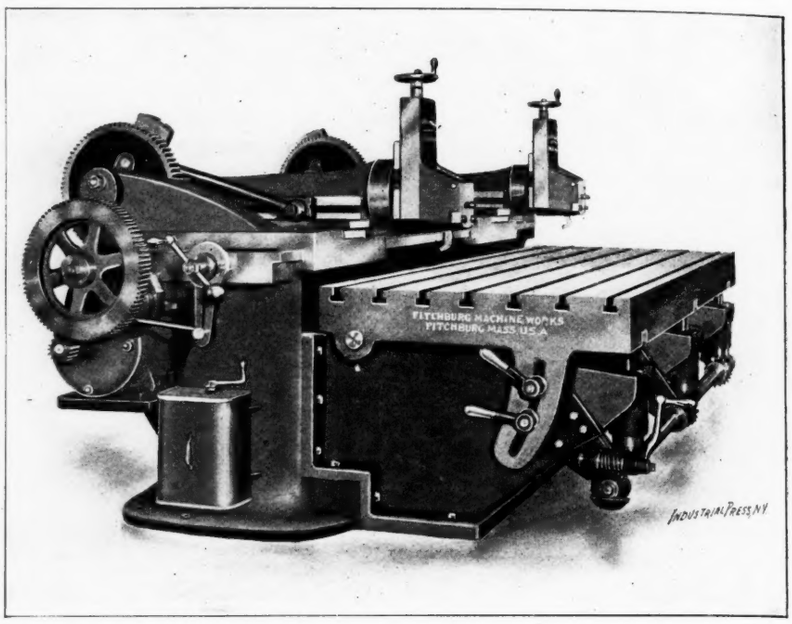
A new slitting shear, the "Lennox" rotary sheet shear, has been recently brought out for shearing sheets and light plates. It was built to meet the demands for a rotary shear of comparatively light weight and low cost and the rotary principle adapts it to curved work as well as to straight work. It is made in three sizes to cut steel, ⅛, ¼ and ½ inch and lighter. Joseph T. Ryerson & Son, Chicago, are the exclusive sales agents.

FORBES DIE STOCK.

An important improvement has been made in the Forbes die stocks, manufactured by the Curtis & Curtis Co., of Bridgeport, Conn. This is an adjustment of the shell or casing so that the wear of the gear is taken up. In many machines for cutting the threading pipe, the gear wears itself loose in the shell after a time, so that a perfectly straight thread is not easily obtained. This difficulty is wholly overcome in the Forbes die and stock. The dies used are cheaper than solid dies and much more durable. All parts of the machine are interchangeable.

NEW SHAPER.

A heavy shaper of special design has recently been completed by the Fitchburg Machine Works, Fitchburg, Mass., and is shown in the accompanying illustration.



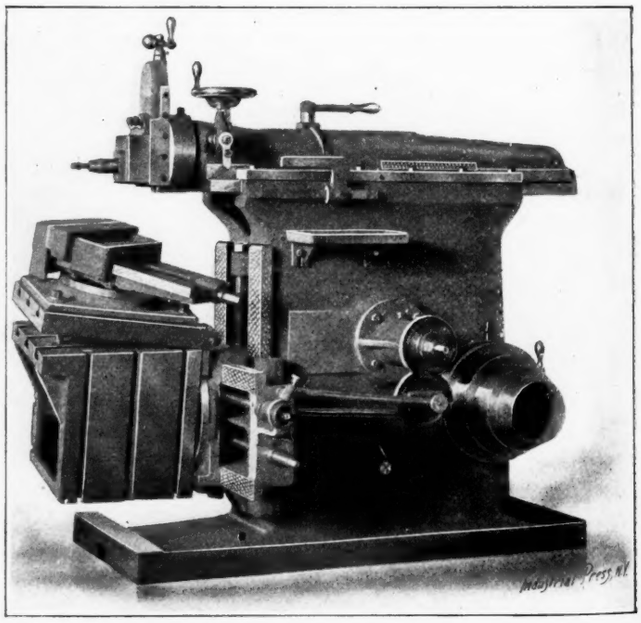
Fitchburg Machine Works Shaper.

The machine is designed for scarfing ship plates. It is made with a draw cut so that the heaviest work comes at the end of the stroke when the ram and crank are in the most advantageous position.

The two heads are independent, each driven by an independent, variable speed motor. The stroke is 18 inches and the bed 10 feet long. The work table is made very heavy and is adjustable to any necessary angle. The machine can be made with the ordinary cone drive if desired. It weighs 17,000 pounds.

TWENTY-FOUR INCH SHAPER.

The shaper shown in connection with this is a 24-inch back-geared shaper made by the Cincinnati Shaper Co., Cincinnati, O., which has several unusual features, making it

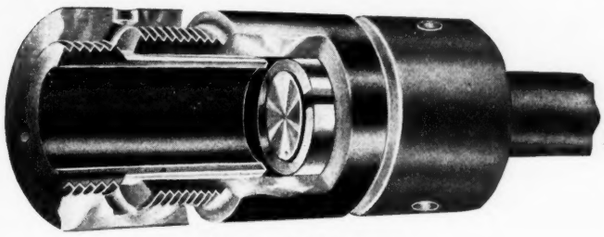


Shaper with Swiveling Knee and Vise.

particularly adapted for mold or die work. It has a rotating or revolving table supplemented by a tilting leaf and the vise is mounted upon a swiveled base, permitting the work to be placed in relation to the tool at any angle, the inclination of the work being in any desired direction. The machine is also equipped with a variable power down feed for the head.

VANDERGRIFT COUPLING.

The illustration of the shaft coupling herewith shows an improved form of coupling made by the Vandergrift Coupling Co., Indianapolis, Ind. It is a compression coupling and consists of only five parts. The central portion shown in the engraving is a sleeve tapered on the inside from the middle out to each end, and threaded with right-hand threads. Inserted in this sleeve are two bushings slotted their entire length, tapered to conform with the taper on the inside of



Compression Coupling.

the sleeve, and threaded at the end with left-hand threads. Two nuts threaded on the inside to screw on the sleeve and on the bushings complete the coupling. When properly attached the coupling will "wind itself up" and the heavier the load the tighter it will grip the shaft, aligning them perfectly. The coupling has no projecting parts to injure workmen. A spanner wrench and two interlocks accompany each coupling. By the use of these interlocks, according to directions furnished, the coupling is made to tighten on the shaft whatever the direction in which the shafting is running.

* * *

Until within a short time ago there were, with a few minor exceptions, no other types of drawbridge used in the United States except the swing bridge requiring a central pier and swinging in a horizontal plane. Many fatal accidents have occurred with this form of bridge by trains running into an open draw by failure of brakes or some one of the other accidents by which control of a train is lost. In Chicago and Cleveland there have been erected recently drawbridges of the Bascule type known as the Scherzer rolling lift bridge. As the name of the type implies, these bridges are built on the same principle as the drawbridges of ancient castles—that is, they lift in a vertical plane instead of swinging in a horizontal plane. A very good description of a drawbridge of this type built for the Big Four at Cleveland over the Cuyahoga River appeared in the February issue. An accident recently occurred in Chicago on a Scherzer rolling lift bridge on the line of the Metropolitan West Side Ry. that demonstrated the safety feature of this type. The motorman either lost control of an electric elevated train or disregarded the danger signal, and ran into what corresponds to an open draw, but because of the angle at which the span stood, the cars ran part way up and then stopped and ran backward without causing serious damage to either the cars or passengers.

* * *

OBITUARY NOTES.

Edward Kowaleuski, of the firm of Kowaleuski & Ruesch, of Newark, N. J. manufacturers of machinery, died recently at the age of 38 years. Mr. Kowaleuski was at one time in the employ of Gould & Eberhardt, of Newark, and later became superintendent at the works of Stiles & Parker. Some years after he became connected with the Universal Radial Drill Co., where he remained until he engaged in business for himself.

Edward Flather, of the Flather Machine Co., Nashua, N. H., died on April 7 at the age of 63. Mr. Flather was of English extraction, but came to this country in 1856, when he obtained employment at the U. S. Government Arsenal at Harper's Ferry. Later on he became connected with the Howe Sewing Machine Co., but during the war he again entered the service of the Government as inspector of arms at Colt's Armory. He also served in this capacity at the Stars arms factory, Yonkers, and at the Jocelyn Fire Arms Co., of Stonington, Conn. Still later he accepted a position with the Elias Howe Sewing Machine Co., Bridgeport, for which company he invented many machine tools for reducing the cost of manufacture of the sewing machines. Mr. Flather was afterwards promoted to the position of superintendent of the Howe Co., which position he held for nearly twenty years. He finally resigned his position of superintendent to engage, with two of his brothers, in the manufacture of lathes. The firm name was the Flather Machine Co. He was an inventor of prominence and from his boyhood very much interested in everything pertaining to mechanics.

* * *

FRESH FROM THE PRESS.

THE ELECTRICAL CATECHISM compiled from the regular issues of "Power." Published by the Hill Publishing Co., World Bldg., New York. 210 8-vo. pages illustrated. Price $2.00.

The matter in this book is largely made up from a series of articles in catechism form that have appeared in "Power." The aim has been to present only such branches of electrical work as come within the range of the average central station or isolated plant engineer. The explanations are given in clear every-day English, and the book should prove very acceptable to one who is looking into the general principles of electrical work and does not feel disposed to go deeply into the theoretical part of the subject. Such calculations as are given are made very clear and there are about 250 illustrations made with a view to explaining the general principles on the subject.

ELECTRIC AND MAGNETIC CALCULATIONS, by A. A. Atkinson. Published by D. Van Nostrand Co., 23 Murray St., New York. 310 12-mo. pages. Price, $1.50 net.

This, as the name implies, is a book of electrical calculations in which are a great many problems with calculations worked out and with explanations. It is designed for students who are trying to become grounded in the rudiments of electricity. A large part of the matter was prepared as an introduction to a course in electrical engineering. The book will also be found a helpful companion to engineers and superintendents who can use it as a handbook for reference for calculations that frequently occur in practice.

ALTERNATING CURRENT MACHINES, by Samuel Sheldon and Hobart Mason. Published by D. Van Nostrand Co., 23 Murray and 27 Warren Sts., New York. 260 12-mo. pages, illustrated. Price, $2.50 net.

Some time ago we reviewed a book by the same authors upon dynamo electric machinery, in which direct current machines were considered. This book is of the same size and style as the former one and is intended to supplement it. It is designed for engineers not familiar with the subject of alternating current but whose work leads them into this field, and it is also intended for those who are studying the subject by themselves and have acquired some proficiency in elementary mathematics. The mathematical part of the book includes but little mathematics higher than algebra and trigonometry. Considering the extent to which a mathematical discussion can be carried in connection with alternating current, the subject appears to be treated in a practical manner, and the book is to be recommended. It is profusely illustrated and subjects like transformers, converters, motors, etc., are fully presented.

ADVERTISING LITERATURE.

THE CHAMBERSBURG ENGINEERING CO., Chambersburg, Pa. Catalogue No. 28 of hydraulic machinery, steam and pneumatic riveters, etc.

THE ADAMS CO., Dubuque, Ia. Standard catalogue No. 6, describing and illustrating the Farwell automatic molding machine for making snap molds.

A. W. GUMP & CO., 20-24 No. Canal St., Dayton, O. Pamphlet containing a list of first-class, modern, second-hand machinery, belting and tools for sale by this company.

THE AMERICAN TOOL WORKS CO., Cincinnati, O. Leaflet calling attention to the "American" screw machine. This machine is made in sizes ranging from No. 1 to No. 7.

ESTEP & DOLAN, Sandwich, Ill. Booklet entitled "The Bending Book," which treats of the work done by this company in eye bending, angle bending, ring and hinge-eye bending, etc.

F. F. SLOCOMB & CO., Wilmington, Del. Catalogue, standard size, illustrating and describing the Caskey portable pneumatic punch. This is made in a number of sizes, for large and small work.

THE CURTIS & CURTIS CO., Bridgeport, Conn. Catalogue of pipe cutting and threading machinery for hand and power. The Forbes die stock is shown in various sizes and styles for large and small work. A price list is also given.

THE CINCINNATI MACHINE TOOL CO., Cincinnati, O. Catalogue covering the entire line of the Cincinnati upright drills, which range from 21 to 42-inch swing. A large number of illustrations are given, and in the back is a list of well-known firms using this company's tools.

THE CHRISTENSEN ENGINEERING CO., Milwaukee, Wis. Catalogue 6 x 9, of this company's electrically-operated stationary and portable air compressors. The company are also prepared to furnish compressors of the same styles without the motor, and arranged to be driven by belt, steam or gas, to suit the requirements.

FOOTE, BURT & CO., Cleveland, O. Catalogue of the multiple drills built by this company. These are built in a number of sizes and styles, and have a driving capacity from the smallest up to drills of 2 inches. The drills shown in the catalogue are the regular styles; the company also make many varieties of special drills.

SCHUMACHER & BOYE, Cincinnati, O. Catalogue E, of engine lathes. These range from 18 to 42-inch swing, and are all illustrated and fully described. A half-tone is shown illustrating the company's new arrangement for feeds and screw cutting, used on a 36 and a 42-inch engine lathe. Engine lathes driven by motors are also furnished

NORMAN W. HENLEY & CO., 132 Nassau St., New York. 1902 catalogue of the latest technical books. These books treat of machin-

ery and mechanics, steam engineering, electricity, compressed air, liquid air, locomotives, etc. The catalogue will be found very useful to anyone wishing to procure good books on any of the above subjects.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass. May number of the School's handbook. This is published monthly and contains a list of the officers and instructors of the school and a very complete description of the various courses. These courses include mechanical, electrical, stationary, marine and locomotive engineering; and heating, ventilating and plumbing.

THE DRESSES MACHINE TOOL CO., Cincinnati, O. Illustrated catalogue of screw and turret machinery. This includes screw machines, automatic turret lathes, plain and back-geared; forming lathes, turret brass lathes, universal monitor lathes and plain hand and speed lathes. They also manufacture a complete line of radial drill presses, a catalogue of which will be sent to anyone on application.

THE AMERICAN BLOWER CO., Detroit, Mich. Illustrated sectional catalogues Nos. 139 and 140. The former treats of the A. B. C. "Moist Air" and "Blower" dry kilns and contains a very great number of testimonial letters from firms using the dry kilns. Also much useful information about the drying of lumber. No. 140 deals with the A. B. C. disk ventilating fans, which are made in a great variety of sizes and styles.

THE COLUMBUS PNEUMATIC TOOL CO., Columbus, O. Illustrated catalogue of the No. 2 U. & W. piston air drill for locomotive work, manufactured by this company. This drill is made entirely of steel, with the exception of the frame and cylinders, which are of bronze. It does work in very close quarters. It is a slow-speed tool, and hence will not burn the twist drill; it has only 12 working parts, is provided with roller bearings and drills from ⅝ inch to 2 inches in steel.

THE HART MFG. CO., Cleveland, O. 1902 catalogue and price list of "Duplex" die stocks and thread cutting tools. These dies are of steel and when necessary can be sharpened easily on a grindstone or emery wheel. The catalogue illustrates the "Duplex" die stocks for pipe, ratchet die stocks, die stocks for pipe and bolt combined, for bolts, for gas and electrical fixture work, etc. Also pipe taps and reamers, machinists' hand taps and tap wrenches. A table of the standard dimensions of wrought-iron pipe is given, and also a telegraphic code.

HENRY FERRIS, "ad." writer and adviser, 920 Drexel Building, Philadelphia, has published a little booklet which is full of valuable points for advertisers in every line, and will be sent free to all who request it. Mr. Ferris has ceased to take commissions from publishers, arguing that he cannot fairly represent the advertiser whom it is his business to serve, and take commissions from people who are selling the advertiser space and whose interests are often, if not always, diametrically opposed to his. One paragraph in Mr. Ferris's booklet contains some sound advice which, if accepted, would result in the saving of thousands of dollars to advertisers. He says: No advertising rule that I have ever followed has been so invariably successful as this:—Concentrate on the best mediums, and cut off the rest. "Cutting off the rest" alone usually saves an advertiser more than all my services cost him. After I have cut off one-fourth of his expenditure, the rest, with well-written advertisements, often brings him twice as much return as the whole amount brought before.

MANUFACTURERS' NOTES.

THE E. W. IRWIN MACHINERY & SUPPLY CO., Cleveland, O., have established a branch office at 114-118 Liberty St., New York.

THE CLEVELAND PNEUMATIC TOOL CO., Cleveland, O., have appointed the Compressed Air Machinery Co., San Francisco, Cal., to represent them on the Pacific Coast.

THE CHICAGO PNEUMATIC TOOL CO., Chicago, Ill., announce that they now occupy the tenth floor of the Fisher Building, Chicago, for their general offices.

THE NEW DOTY MFG. CO., Janesville, Wis., are building a pattern storage room 40 x 80, three stories high. They will put in a new pattern shop and also add 60 feet square to their machine shop and install a lot of new machinery.

THE AMERICAN BLOWER CO., Detroit, Mich., have recently received an order from the University of Chicago for two large fans—one for induced and the other for forced draft. This is the second order they have received from the University.

THE NATIONAL-ACME MFG. CO., formerly of Hartford, Conn., have removed to Cleveland, O. Their large new works are situated at Stanton St. and C. & P. R. R., and have been in operation since June 1st. They report a great number of orders.

PAWLING & HARNISCHFEGER, Milwaukee, Wis., makers of electric traveling cranes and hoists, advise that the condition of business remains entirely satisfactory. They have sent us a list of twenty-four orders they have recently booked from representative firms.

CHAS. H. BESLY & CO., Chicago, Ill., are about to begin the building of a new store at 15-17-19-21 Clinton St. It will be 80 x 150, with a foundation for four stories in addition to the four they are now proposing to erect. The new building will have light on three sides and will be the finest store of its kind in Chicago.

M. H. TREADWELL & CO., builders of special machinery, have opened an engineering and selling office at People's Savings Bank Building, 307 Fourth Ave., Pittsburg, which is in charge of Mr. L. L. Knox. This office has been opened to take care of the increasing business in and around the steel plants of Pittsburg.

CHAS. H. BESLY & CO., Chicago, Ill., have within the past month received orders for their Gardner grinders from California, New York, Rhode Island, Connecticut, and New Jersey. Many shipments of Helmet oil and Badger and Bonanza grease cups are being made to all parts of the country.

THE GEO. GORTON MACHINE CO., Racine, Wis., are about to build a new shop 50 x 125, slow-burning construction, and are in the market for material. Their business in universal and plain disk grinding machines has increased very rapidly during the last year or two, having entirely outgrown their present quarters.

THE UTICA INDUSTRIAL CO., Rome, N. Y., announce that they are in the market for small tools such as used in high-class machine work, and would be pleased to receive catalogues from manufacturers, with discount sheets. They are fitting a shop for the manufacture of high-grade automatic machinery.

THE FRED J. SWAINE CO., St. Louis, manufacturers of presses, dies and sheet metal machinery, are erecting a new factory on the N. E. corner of 7th and O'Fallon Sts. This is to be a modern and thoroughly equipped shop and when completed will be over twice as large as their present location.

THE BURT MFG. CO., Akron, O., have received a fifth order for oil filters from the Atlas Portland Cement Co., Northampton, Pa. They have also recently made shipments to England, Austria, Belgium, Mexico and the Argentine Republic, and to different cities in India, China, Japan and the Philippines.

THE CURTIS & CURTIS CO., Bridgeport, Conn., have received a handsome certificate setting forth that a medal was awarded to them for their exhibit of pipe-threading machines at the Paris Exposition in 1900. The certificate was lately received from the United States Commissioner to the exposition.

THE Q. AND C. CO., manufacturers of railway specialties, machinery and pneumatic tools, announced that beginning June 1st they would operate in their own name. Their principal offices are at the Western Union Building, Chicago, and in New York at 114-118 Liberty St. Their general sales department is located at their shops, Chicago Heights, Ill.

THE MICHIGAN MFG. CO., Ypsilanti, Mich., have bought the business of the Danielson Machine & Tool Co., Cleveland, and in connection with the manufacture of their own products will continue the manufacture of the Danielson sheet metal machinery, presses, etc. Mr. G. F. Danielson, formerly President of the Danielson Co., will hereafter be connected with the Michigan Mfg. Co.

THE CHICAGO PNEUMATIC TOOL CO., Chicago, Ill., have been awarded contracts for three of their large "Franklin" air compressors for the Philadelphia & Reading Railway; two compound air compressors of 2,000 cubic feet capacity for the new car shops of the New York, New Haven & Hartford Railway, of Readville, Mass., and one for the Atchison, Topeka & Santa Fe Railway.

THE EMMERT MFG. CO., Waynesboro, Pa., manufacturers of the Emmert vise, are to erect a new two-story brick building to enable them to double their output. The company report a great rush of orders. They state that they will be in the market for new machinery for the equipment of their new shop and that the force of workmen will be about doubled when the machinery is ready for use.

THE ARMSTRONG BROS. TOOL CO., Chicago, Ill. have completed the re-equipment of their plant and have entirely recovered from the confusion and delay incident to the fire from which they suffered recently. They state they have largely increased their facilities and are now in shape to take care of their rapidly increasing business, having 30,000 square feet of floor space and an ample equipment of up-to-date machinery for the manufacture of the Armstrong tool holders.

THE AMERICAN SCHOOL OF CORRESPONDENCE, Boston, Mass., sends us a list of students who have recently completed courses. Among them we note two who have taken full courses in 16 months and one a fireman who completed the stationary engineering course while pursuing his regular work, although handicapped by not being familiar with English at the time of his enrollment. Among the students recently enrolled is a Greek whose home is at Athens, but who has been in this country taking an engineering course at a technical school.

THE PHILADELPHIA PNEUMATIC TOOL CO., Philadelphia, Pa., inform us that they are now entirely settled in their new quarters at 21st St. and Allegheny Ave. As a result of the moving they are somewhat behind in making shipments, but their works are being run night and day, and they state that at no distant date orders will be filled with usual promptness. Recent large orders have been received from the Southern Pacific Co., from the Newport News Shipbuilding & Dry Dock Co., the Pennsylvania Railroad Co., the Lackawanna Steel Co., and others.

THE U. BAIRD MACHINERY CO., Pittsburg, Pa., have changed their firm into a corporation with a capital of $200,000, with H. A. Reed, President; C. A. Wolf, Vice-President and Treasurer, and O. P. Meckel, Secretary. There is no part of the country where business has been so active during the past prosperous years as in that section of which Pittsburg is the center, and the U. Baird Machinery Co., who for many years have been the leading machinery firm in that city, have received their full share of this prosperity, as is shown by the increased business which requires the addition in capital mentioned above.

CINCINNATI NOTES.

THE WM. E. GANG CO., Cincinnati, O., have added a gallery to their shop, for their light machinery. This gives them considerably more room.

THE TUCKER MACHINE CO., Cincinnati, O., are going to manufacture a full line of grinding machinery, and will probably be ready by August 1st.

JNO. STEPTOE & CO., Cincinnati, have begun work on their new factory. They will have 22,000 square feet of floor space on Colerain Ave., near Hopple, and plenty of room for future additions.

THE R. K. LE BLOND MACHINE TOOL CO., Cincinnati, O., are building an addition 40 x 100 feet to their shops. One half this space will be used for a blacksmith shop and the balance for a Sturtevant generating set.

THE AMERICAN TOOL WORKS CO., Cincinnati, O., have just opened a new store and office in the heart of the machinery district of St. Louis, at 720 North Second St., where a representative stock of their machines will be on exhibition. Mr. A. B. Bowman, who has long been identified with the machinery business is agent of the new office.

THE NORWOOD BICYCLE CO., Cincinnati, O., have changed their name to the Norwood Machine & Mfg. Co. The change, they announce, is only in the name and will not affect the company nor its relations to those with whom they have had business dealings. All outstanding accounts are payable to the company in the new name. The business has been thoroughly reorganized and improvements made in their factory which will enable them to turn out good work promptly.

THE CINCINNATI SHAPER CO., Cincinnati O., are now building new shops at Elam St., between Colerain and Spring Grove Aves., near the Lodge & Shipley Works. This shop will be located in the new machinery section of Cincinnati. The main works are 30 feet front and 290 feet deep. There is to be a boiler and engine house and wash room which will be semi-detached, and 41 x 76 feet. The office, drafting room, etc., will be in a building 30 x 90 feet and two stories high.

THE LODGE & SHIPLEY MACHINE TOOL CO., Cincinnati, O., are adding to their shops an extension 60 x 120, two stories high. On the first floor will be installed eight new machines and the second will be used for a pattern shop. They also have an extension to the main shops, 180 feet long and 90 feet wide, in which will be installed a traveling crane made by Pawling & Harnishfeger, of Milwaukee; a warehouse 40 x 25 feet and an extension to their Shop No. 2, 60 feet long, two stories.

MISCELLANEOUS.

Advertisements in this column, 25 cents a line, ten words to a line.

The money should be sent with the order.

A MANUFACTURING CONCERN in Northern Ohio thoroughly equipped with entirely new plant for turning out light or medium weight tools of any character suitable for machine shop trade, would like to correspond with parties desiring same manufactured on royalty. Address MANUFACTURER, 9-15 Murray St., New York.

FOR SALE—Patent No. 695,793, Setting Instrument, dated March 18, 1902. Will sell entire patent. New tool for machinists, can be used for various purposes; will sell at sight; every machinist needs one. Good chance for small tool manufacturer to put with his line of machinists' tools. Send for descriptive circular at once. Address, MORRIS CHAMBERLAIN, Bartley, N. J.

(Continued on page 42.)